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Fundamental Research on Evaporation

EVAPORATION and condensation are among the most valuable unit processes of chemical industry. Does a solution need to be concentrated, do we desire to recover a solute from a solvent or vice versa, do we wish to cool a liquid, or do we wish to remove a liquid from a gas? In each of these instances the unit operations of condensation or evaporation are employed. Evaporation may be effected by the direct supply of heat to the free surface of the liquid, the vapour being swept away by inert gases; or with the same method of supplying heat the vapour may be allowed to be evolved undiluted without the agency of carrying gases; or either of these methods of removing the vapour may be combined with the transfer of heat to the fluid through solid retaining walls. For condensation the most usual method is to allow cooling water and vapour to flow in counter-current, the one passing through tubes, the other outside them.

This elementary statement is necessary to define the limits of application of a highly important research into evaporation conducted at the National Physical Laboratory and recently reported to the Institution of Chemical Engineers by Mr. R. W. Powell and Dr. Ezer Griffiths. The research in question deals with the evaporation of water from plane and curved cylindrical surfaces and concerns only processes wherein the vapour is removed by the agency of a current of inert gases. The results have the further limitation that they apply only when the gases flow over the surface of the liquid, and not when they are bubbled through the liquid. They apply, for example, to solar evaporation, to evaporation in pans (however heated), to evaporation where the liquid passes over the surface of brushwood or of heated tubes, and to water-cooling frames. It is, in a sense, surprising that so fundamental a process should be so little understood that the disagreement between the results of previous observers should make the investigation necessary.

One aspect of the problem neglected by previous experimenters has been the contribution to the rate of evaporation of each of the several portions of the surface. This has received special attention from Mr. Powell and Dr. Griffiths. Perhaps the most interesting result is that the rate of evaporation per unit area depends upon the extent of the surface. The rate of evaporation of a liquid from a surface of limited area cannot therefore be treated as applying to *any* surface under those conditions. It would appear that the larger a water reservoir, the less is the rate of evaporation. Apart from the application of this principle to large tanks and to solar evaporation, it seems doubtful whether it has any particular application to chemical engineering, provided that care be taken not to base experimental data on a very small surface. For example, it is found that with the same air velocity the rate of evaporation over the first sq. cm. where the air enters, is double that over a whole area 18 by 24 cm., whilst the mean rate of evaporation from a strip 1 cm. wide at the front of the surface is 2.6 times as great as that from a similar strip 23 cm. farther away from the front edge. It is not clear from the paper whether this is simply the result of increased saturation of the air current or whether it is due to turbulence when the gases first impinge on the surface; if due to turbulence, the result has an immediate application to chemical engineering practice.

That turbulence has an important effect is shown by experiments in which a ridge, in one instance 3.7 mm. and in another 7.5mm. high, was placed near the leading edge where the incoming air impinged. Experimental results showed that the effect of this ridge was to increase the velocity of the air near the surface as soon as a sufficient distance from the ridge had been reached so that the shielding effect disappeared. In this way, which is essentially the creation of a higher air turbulence, the total evaporation from a surface 23 cm. in length was increased by 14 per cent. with the smaller ridge and by 30 per cent. with the higher ridge. The turbulence caused by the ridges is also shown by the entirely different distribution of the vapour pressure over the surface; with the ridges the concentration of water vapour in the air near the surface was greatly reduced and the vaporised water was distributed throughout a far deeper stratum of air. The value of turbulence in promoting evaporation—and presumably in promoting condensation also—is of such proved importance that the utmost care should be taken to avoid any suspicion of streamlining in the design of apparatus for either of these unit processes.

Designers of water-cooling frames will be interested to note that the cooling of liquids by air current depends primarily on evaporation, even when the humidity is well above 80 per cent. An experimental result at a surface temperature of 40° C., for example, showed that the relative amounts of heat lost from the surface by radiation, convection and evaporation were as 1 : 1.25 : 8.5 (humidity 80 per cent.); as 1 : 1.25 : 9.4 (humidity 60 per cent.); and as 1 : 1.25 : 10.5 (humidity 40 per cent.) It is evident, therefore, that the attainment of a high velocity of air flow, the flow being as turbulent as possible, will promote rapid cooling of the water in cooling frames.

Notes and Comments

A Great Experiment

FUEL experts were provided with a feast of scientific information on the development of the Billingham coal hydrogenation petrol plant on November 20, when Mr. Kenneth Gordon, to whose courage and initiative the scheme is largely due, presented to the Institute of Fuel in London a paper reviewing the chemistry and history of hydrogenation, the large scale development at Billingham, the efficiency of the process and the quality of the product. The subject has three distinct aspects—the scientific, the economic and the political—and Mr. Gordon rightly confined himself to the first of these. From the other two points of view the scheme is at present a great experiment. Considerable time must elapse before the verdict can be pronounced upon its economic results. In the meantime the nation may congratulate itself on the fact that Imperial Chemical Industries is carrying out the experiment so that it may know what hydrogenation can do, how much it will cost and the various factors which can only be revealed by a plant of this kind.

The results obtained so far are satisfactory, but Professor W. A. Bone estimates that we must wait for two or three years before we can pronounce any official opinion on the economic side, for then the plant will be tried out further, costs will be known and many other factors will be assessed.

Traders and Transport

TRADERS are becoming concerned at the trend of events in transport. One of the main objects of the Road and Rail Traffic Act, 1933, is to divert traffic from the road to the railway, and the railway companies are adopting a determined attitude with regard to the issue and renewal of licences in favour of road vehicles. Difficulties have been and are still being experienced with " A " and "B " licences, the granting of which lies within the discretion of the various licensing authorities who are empowered to attach conditions to " B " licences whether for " claimed " or " discretionary " tonnage, restricting the users of these vehicles within a certain radius, and for the conveyance of certain classes of goods only. In addition " security " conditions are attached to every licence issued, whether " A," " B " or " C," and failure to comply with the requirements of the Act may lead to the revocation or suspension of a licence and police prosecution.

The interests of traders, and the public they serve, will be best achieved by ensuring a continuation of competitive means of transport, and the right of the trader to decide whether he will operate his own motor vehicles, employ independent road haulage, or send his goods by the railways. The Traders' Defence Association, although principally concerned with the vital question of railway " agreed charges," realises that it can also render its members useful services in regard to the licensing of road vehicles, in advising them upon the difficulties with which they are confronted arising out of the operation of this Act and the regulations issued thereunder. The complexities of the Act are so numerous as to demand the services of experts. The solicitors acting for the Association are specialists in traffic work, and already represent several important trade organisations. Traders are desirous of obtaining and holding their licences without friction with the law, but circumstances may arise which call for support in the general interest of road users when the services of the Traders' Defence Association may be beneficial in helping to obtain a favourable decision. The Association's address is 37 St. Nicholas Street, Bristol.

Import Duties and Chemical Production

THE trend of production during 1933 in 44 out of 74 trades and industries in the United Kingdom which were affected by the imposition of the 10 per cent. ad valorem customs duty on imports by the Import Duties Act, 1932, is reviewed in a volume issued this week by the Stationery Office. This investigation was provided for under the Act, and 1933 is compared with 1930. The other 30 trades will be dealt with in a second volume. The outstanding feature of the report is that while the value of production in 1933 was lower than that of 1930, the volume was higher. Taking 100 as the volume for 1930, the figures for 1933 were: Textile trades, 121; leather and clothing, 106; food, 112; chemicals and allied trades, 112; and miscellaneous trades, 112. While some trades had an increase in the average number of persons employed, every section, in the aggregate, showed a reduction.

In the chemical and allied trades the total gross output for 1933 was £153,025,000, against £161,172,000 in 1930, while the average number of persons employed was 164,808, compared with 167,719 respectively. At 1930 average values the total for 1933 should be £181,840,000.

Industry and the Distressed Areas

TWO important proposals regarding the distressed areas were made by Sir Harry McGowan, chairman of Imperial Chemical Industries, at the annual dinner of the British Electrical and Allied Manufacturers' Association last week; first, that both the Civil Service and big industrial concerns should lend qualified men to examine the suitability of different industries for special areas; and second, that the Government should consider making a cash contribution towards the capital requirements of individual industries established in those areas, this contribution to be limited to a percentage of the amount expended on fixed assets. One of the greatest assets to industry in the United Kingdom is the skilled labour of the British people, to preserve and develop which no effort should be spared. As regards finance, money will have to be risked and the loss of some must be faced.

No one realises more than Sir Harry himself the revolutionary character of his second suggestion, for which there may be no precedent, but in his view desperate ills require desperate remedies. If such a suggestion should carry with it any semblance of Government control then he would not advocate it for a moment, for while he considers it to be the duty of Government to help private enterprise in a broad and general sense he deprecates strongly any Government interference on control in its administration.

Wanted—An Intelligent Youth

By Dr. S. H. TUCKER*

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ONE often hears it said, in a tone of great surprise, that so-and-so is out of work even although he, or she, has a university degree. Well knowing, as we do, some who have obtained the B.Sc., or even higher degree, *we* are *not* surprised. If we had positions to offer, we should not accelerate our course to bankruptcy by appointing them. It is a standing joke. But why should it be? To have obtained what is undoubtedly an honour, and what, in association with other students, is undoubtedly a mark of scholarship, should be above joking about. Unfortunately, however, a university degree is not a hall-mark, necessarily, of intelligence. It can be and is acquired by sub-intellectual processes.

Employers are searching, even in days when unemployment is so prevalent, for *intelligent* workers. And so often have they found that a degree is merely camouflage for ignorance that they have come to associate the two. There would be no contempt for university degrees if their possessors showed what I will call until I make my meaning clearer—ordinary intelligence. Why is it then that university degrees signify so little to employers? I think that both universities and students are to blame. Let us consider the question with regard to the student.

Pleasure of Paying Fees

Numbers come to universities and technical colleges with no desire whatsoever for learning. They have learnt by experience, or their parents have for them, that it "pays" to have a university degree, so they come up to get it; the requirements are (a) to attend a minimum number of classes, (b) to take certain obnoxious examinations, and (c) have the undoubted pleasure of paying *fees*. One can, under certain circumstances, avoid classes and examinations, but never fees. I suggest in all seriousness it is examinations and fees which are to a considerable extent responsible for this antagonism to the system. Fees will be abolished one day, and the examinations so altered as to be no longer the happy hunting ground of the "swot." Classes will then be taken in the pursuit of learning.

Undoubtedly all students have to take certain subjects in which they are not at all interested, and inevitably any method is resorted to which will ensure that the examination is passed, which frees them from prosecuting further study in that subject. But the examining bodies are chiefly to blame. They play into the hands of such opportunists. The primary rottenness, to my mind, is in the type of examination question set. Most questions require for answering reproduction of facts which can be pitch-forked directly from lecture-notes. A student may be able to produce these without having any idea of their intrinsic value. Thus he possesses knowledge, but intelligence consists in being able to associate these facts, and in being able to use them to arrive at new ideas.

The Correct Type of Question

The modern type of examination question aggravates the condition of the sufferer, and such a system asphyxiates intelligence. The correct type of question is one in which he is required to draw on his facts, and then by analogy and inference, involving conscious or unconscious processes, arrive at an answer. The really bad type of question is: "What is acetoacetic ester, and how would you prepare a methyl derivative from it?" Knowledge of the answer is essential for the B.Sc. standard, but it is all book work, and can be given after conjuring up the image of a certain page in the text-book, and requires no reasoning. Most people would be floored had the question been set thus: "Give examples of simple β-keto-carboxyesters, and indicate how alkyl derivatives may be obtained from them." Or put the question in the form of a problem: "Write the formula of a ketonic ester, $C_7H_{12}O_3$, which gives methyl propyl ketone on hydrolysis." Or, "How would you prepare optically active valeric acid?" Or, to change the question in another sense: "Write the formula of the base C_6H_7N which can be oxidised to an acid $C_6H_5O_2N$." These are not trick questions; I contend that *all the isolated facts are known to the student, but that utilisation and correlation of them has not been practised.*

The average student is eternally complaining, and the echo comes back from the employer, that the real trouble is that a university or technical college training does not fit him for any particular employer, or any particular job. An academic training should not be expected to train a man for *every* job or any *particular* kind of job, but make him *adaptable* to conditions as he finds them in *any* job. Such a man I consider to be intelligent.

Facts and Principles

How, then, is an institutional training to do this? In the first place it must not put emphasis on learning facts but it must from these facts guide the student into deriving general *principles* which he can retain and use.

The student has very little to complain of in his *course*, especially in a technical college. At the present time it is adapted by men who know industry and its requirements, but who place higher education in their particular branches of study in the foreground. The fundamental work of training institutions in producing intelligent youths is to train them to think for themselves. The retention of facts is of secondary importance. One must train oneself to look for essentials, to concentrate on them and leave the non-essentials to come incidentally. Let me show you what I mean by essentials. Thus to remember the fact that ethyl alcohol boils at 78°, and that as one ascends the homologous series of alcohols, the increase in boiling point is, on an average, 20° are correlating facts which enable one to compile the table of boiling points of the normal alcohols.

Association of facts is the only intelligent method for remembering and retaining them. But, *generalisation must never be carried too far.* Generalisations are often only empiricisms; and even principles, embodied in laws, are often only elaborated or simplified, empiricisms to which no exceptions have been found. Whenever you make rules you must be prepared to accept exceptions, since the perfect rule, the absolute law, can never be discovered. Generalisations cannot always be used to predict what will happen in new cases, at least, not infallibly. The intelligent youth must know, and admit that he knows extremely little, compared with the vast amount he may yet know and the infinite amount he will never know. He must never allow his ideas to become stereotyped, but be prepared to abandon his generalisations, and much more so his theories, immediately the necessity arises. In other words, he must cultivate a free imagination.

Danger of Blind Faith

A child believes implicitly in the omniscience of the adult. Similarly, unintelligent adults repose extraordinary faith in the opinions of the heads of their profession. Perhaps the modern student is not so easily impressed: he tends to go to the other extreme, and refuses to take even advice from

* Abstract of a Lecture delivered to the Andersonian Chemical Society at the Royal Technical College, Glasgow, on November 8.

experienced men. But as he grows he becomes more and more inclined to "make use of" tutors; then he must be careful not to consider them infallible. All the same, a theory propounded by someone whose judgment is valued, is liable to be accepted without being subjected to the personal criticism it should get. A classical example of this is given by the faith of the disciples of Aristotle, who quoted his works to prove that a weight of ten pounds fell ten times as rapidly as a weight of one pound, in spite of the fact that Galileo showed them that the two arrived at the ground simultaneously. Note also, how long after Lavoisier had pointed a better way, chemists remained obstinately attached to Stahl and his Phlogiston Theory.

Do not be prejudiced by previous conceptions. The outstanding chemist is he who can distinguish fact from misconception, and with imagination suggest new explanations which co-ordinate all the new, as well as the old facts. Thus, to discover a periodic table is statistical compared with elucidating the vagaries of radioactivity. In such a research there are few signposts, and those there are, are entirely misleading. The greatest difficulty that the intelligent chemist has to face is that of divesting himself even of *fundamental* ideas. This might be further illustrated by some recent work such as the work done by Wieland with regard to the oxidation or rather "dehydrogenation" of alcohols and aldehydes; or as the work of Cohen, Cook and Hewett relating to the sterols, bile acids, vitamins and sex hormones.

Need for Relaxation

A word about relaxation. The average student works too hard. Again the system under which he works is at fault. He is expected to cover too much ground in the time. I contend that either the amount of work to be done should be reduced, or that the time of the course be extended. The necessity for swotting could be eliminated, and the old ideas of thinking and browsing in a subject regained in practice. Now, a student may not "waste time" pondering over the views of men and the theories held, he has got to "get them up," and be word perfect, by the time the examiner may ask him for them: he is not asked for opinions. They might conflict with those of the examiner and that would be unpardonable. Remember that impressions received when one is stale, overworked and thus unfit, are indefinite and inaccurate. The intelligent worker will spend a good deal of his time in the open air, preferably engaged in sport of a kind which will keep his mind off his work. The modern student of psychology will also relax *in* his working hours. Thus, after, say, one hour's vigorous work, one should, if under possible conditions, sit down for two or three minutes and relax, muscles and mind. A pause, and after the pause a reconsideration of what we are doing, would prevent us going on with much ineffective, ill-directed and incompletely thought-out work. Again, planning is strongly recommended by some. But when you set out according to plan see that you go to the end with it. *Know where you want to get, be determined and persistent in getting there, and you will arrive.*

Knowledge of Languages

An intelligent chemist knows that he must know more than chemistry. In fact he cannot keep up to date unless he has a good knowledge, particularly of languages. The most intelligent way of acquiring this knowledge is to go to the particular country for the long vacation, and live with a family, the members of which cannot speak English. To have even facility with German and French may fit him for a secretarial post which requires a scientific training to deal with correspondence and so on. Besides this, and the general "broadening" effect of travel, it enables one to enter other laboratories, see how they are equipped and run, and especially does it give one the golden opportunity of meeting the great chemists and hearing them lecture.

Do you ever think how intelligent people are who specialise in more than one line? I do not mean specialised study of branches of chemistry, but other study directly related to, or usefully connected with, the pursuit of chemistry, *e.g.*, engineering, biology, or, broader still, medicine or law.

I shall conclude with a striking illustration—the story of an eminent man—Lord Fletcher Moulton—whose name is known to some of us, but is unknown to the majority. Moulton was educated at Kingswood School, Bath. He gained a scholarship to Cambridge and soon excelled himself in mathematics, gaining the coveted distinction of Senior Wrangler in the mathematical tripos. At the same time he was a competent scholar in Latin, Greek and Hebrew, and an expert in French and German. He then took up law and became a leading barrister on patent law. The intelligent man does not stop his studies when he leaves the university or college, he even commences the study of completely new ones. Moulton had the ability of grasping, apparently instinctively, not only the grammar but the genius and spirit of any new language, so he would come to some new branch of scientific work, and in the time of mastering what to most men would seem a few disconnected facts, would gain a knowledge of the subject that enabled him to discuss and appreciate the matter, not merely as a lawyer, but as an expert. His was no scrappy, "swot" knowledge. He insisted on long and full consultations where every possible aspect of the case might be considered, and any objections met with beforehand. The intelligent man, like the genius, takes infinite pains. He considered "practical usefulness" of more importance than "the novel technical effect" beloved of the German Patent Office. He considered that "improvements that led to a better and cheaper process for producing an old result were often practically of greater importance, and might be more worthy of reward, than many new processes." He was very scathing in his views of inventors who will not go to the trouble of working out practically and completing their inventions.

For researches into the nature of electricity Moulton was awarded the F.R.S. He could, with equal facility, give addresses before the Faculty of Medicine of Leeds University, and before the Institute of Engineers. He became a Judge and Lord of Appeal, and when the War came this amazing man became the head of the Explosives Services Committee.

Moulton is said to have been extremely tactful. I think the essence of this is to be able to keep one's temper and argue calmly with difficult people: to avoid being domineering without loss of firmness. A little psychology goes a long way. Try to get a hold of the psychological "make up" not only of the man above you, but also of those below you.

A New Blue Pigment

Unique Display by Imperial Chemical Industries

THE possibilities of a new blue pigment, which combines fastness to light, heat, acids and alkalies with tinctorial strength, were demonstrated at a special display of manufactured goods arranged by Imperial Chemical Industries, Ltd., at their London offices on November 25. Introduced as Monastral Fast Blue BS, this new pigment is anticipated to prove exceptionally welcome in many manufactures. Its fast-to-heat property enables it to be used for colouring rubber under all temperatures of vulcanisation, whereas in the past it was essential to sacrifice many other desirable features in the finished product because no colour possessed them in addition to heat resisting qualities. Until now it has also been impossible to obtain a satisfactory blue pigment for use in distempers, because an absolute fastness to the alkaline nature of lime is as important as brilliance of colour and light fastness. Monastral Blue, however, is quite unaffected by lime even when applied to freshly plastered walls. The fastness of the new pigment towards acids also enables it to be used in various colouring processes in place of other blues which were of unsuitable tone, but which had to be used on account of the acid resisting quality demanded.

Some Aspects of The Solid/Liquid Interface

Dr. W. Clayton Reviews Our Present Knowledge

Dr. W. Clayton, Chief Chemist and Bacteriologist, Crosse and Blackwell, Ltd.

A COMPREHENSIVE review of the general state of knowledge on problems associated with the solid/liquid interface was given by Dr. W. Clayton at the meeting of the Oil and Colour Chemists' Association held at the Institute of Chemistry on November 7. He was, however, only able to treat in limited fashion recent developments and ideas which underlie important features of practical interest. The two inter-related themes constituting the main thesis, namely, (a) the conception of polarisability and molecular orientation, and (b) boundary electric charge, were therefore more or less concentrated upon.

The solid/liquid interface, said Dr. Clayton, introduces us to a great variety of adsorption phenomena, many having technical importance. Adsorption was due, he said, to stray electric fields of molecules whose electrical components were out of balance. It had been contended that adsorption depends in a peculiar manner on special molecular groupings in molecules and reference was made to experiments which have sought to compare the influence of certain groupings in 31 organic acids differing in most cases regularly in chemical configuration, on their adsorption from aqueous solution within definite concentration ranges by carbon. This work was carried out in 1935 and it was found that branched chains have little effect on the maximum adsorption of an acid. Similarly, it had been contended that the adsorption of organic acids by Pt black is essentially a function of molecular structure, the solubility or molecular weight playing a very minor part. Acids with branched chains were less adsorbed than the normal acids, whilst double bonds enhanced adsorption.

Wetting of Solids by Liquids

Commenting that much has been published concerning the wetting of solids by liquids, Dr. Clayton remarked that the latest work indicates the very important fact that certain surfaces can have their properties altered. Stibnites, for example, by heat treatment could function either as hydrophobic or hydrophilic surfaces or even as surfaces which exhibit no selective wetting. Again, galena had recently been shown to be organophilic or hydrophilic, depending upon which liquid first wets the solid. Such changes in wetting were now recognised by various investigators and it had been shown that when certain substances like tallow, shellac and solid fatty acids are melted on water and permitted to solidify, the top surface is not wetted by water whereas the under surface is wetted.

Referring to adsorption and crystals, Dr. Clayton said that the literature on this subject is voluminous, but the recent communication by Bunn, under the title "Adsorption, Oriented Overgrowth and Mixed Crystal Formation," deserved special attention. Bunn dealt with the cause of strong adsorption of certain substances on specific crystal faces and its relation to (a) the oriented overgrowth of different crystals on each other and (b) mixed crystal formation between two substances. X-ray spectra of powder failed to reveal the small amount of impurity present in the crystals, but optical properties furnished evidence of the orientation of the units of impurity with respect to the crystal lattice. The amount of adsorbed material varied with the nature of the face accepting deposition, the concentration of impurity in the solution or melt, and the rate of growth of the crystals. Slowly-growing crystals were more able to reject the impurities arriving at their faces so that the effects of adsorption were more pronounced in rapidly-growing crystals.

The effect of ionic impurities on crystal form was well illustrated, said Dr. Clayton, by the results he obtained in collaboration with the late Professor W. E. Gibbs when working in the laboratory of the Salt Union, Ltd.; other workers had since confirmed these findings. When saturated NaCl solution was evaporated, the salt crystallised in octahedral form if the solution was alkaline and in cubes if acid. In both cases the salt was white and opaque, due to the building up of microscopic crystals with occluded mother liquor. Slow evaporation at about 65° C. of brine acidified with H_2SO_4 resulted in floating crystals which grew to about $\frac{1}{2}$ inch diameter. If, however, the brine had an acidity not less than 0.02 per cent. H_2SO_4 and contained lead in amounts not less than 0.0006 per cent., perfectly clear transparent cubes were formed on evaporation. These cubes had been grown up to 30 mm. diameter and they closely resembled natural rock salt, no difference between the two kinds of salt being observed by an X-ray examination by Professor W. L. Bragg.

Coming to surface films it was pointed out that the spreading of films on molecular laters on the surface of water is now a major technique in the physico-chemical elucidation of molecular structure and dimensions, and attention was directed to some notable work quite recently reported which it was said had led to a valuable new technique being evolved for the X-ray diffraction study of long chain compounds and for practical applications of diffraction information bearing on the lengths, structures and properties (*e.g.*, lubrication) of long molecules.

Points from the Discussion

The PRESIDENT (Mr. G. A. Campbell) said that what they had heard was a very able summary of the state of knowledge of the solid-liquid interface at the present time, the paper representing what was contained in 74 papers—as he had been informed by Dr. Clayton—and much of it published this year. Some of the phenomena which had been dealt with struck at the very root of those with which the oil and colour industry was connected. The apparently simple problem of incorporating a powder with a liquid medium was the lifeblood of the paint chemist, and the paper had shown just how many different conditions affected this matter. In connection with the wetting out of a powder by a liquid, no mention had been made of the effect of pressure in relation to the wetting out properties of a liquid, yet the problem of the paint chemist was one which invariably was carried out under pressure and the usual measurements of wetting out by means of the Bartell cell were also carried out under pressure. It had always been one of his complaints as a

mere pigment manufacturer that the only way of studying the surface of a pigment powder was to study its relationship with some liquid or other. Apart from the recent studies of Professor Finch on electron diffraction it had always been a matter of regret to him that the only resort the pigment manufacturer had was to study the solid/liquid interface rather than the solid powder surface, because that threw the problem more into the hands of the paint manufacturer, to whom the pigment manufacturer was apt to look for guidance rather than tackle it himself.

The author had mentioned instances of the modification of the solid surface by heat treatment and other methods and by adsorbing certain layers on the powder surfaces and there, he (Dr. Campbell) always maintained, was a great field for the pigment manufacturer. The carbon black people had put on the market various brands of carbon black with various modifications of surface properties according to the media in which they were going to be used, and the zinc oxide people had recently put on the market a certain zinc oxide for paint manufacture and another with different surface properties for rubber manufacture.

Mr. W. E. WORNUM, remarking that he had been partly responsible for the selection of the subject matter of this paper, said he was sure everyone would agree as to its great value to the industry. When the author made reference to the ionic condition on the surface of the particles, *i.e.*, to the double layer, he gathered it was meant that the surface condition was largely independent of the character of the liquid medium in which it was placed. Was that so or was a double layer formed on the solid surface with non-ionising liquids?

Pressure in Grinding

On the question of the influence of pressure in grinding, in a great many cases it was not possible to produce very adequate working of a pigment unless it was put through a grinding machine, and if the author could give any clue as to whether when a pigment was ground in a mill there was likely to be any change in the orientation of the molecules on the surface it would be of great value.

Dr. CLAYTON, replying with regard to the question of the double layer, said that the interfaces on meeting differed somewhat and there was evidence of the effects of electric charge. This question had been the subject of very considerable discussion at the last symposium of the Faraday Society on colloidal electrolytes, and the opinion seemed definitely to be that there were certain possibilities for introducing an electric charge. As regards grinding, there was aways the possibility of new planes of cleavage with new possibilities of orientation.

Mr. A. D. WHITEHEAD, referring to the crystallisation of sodium chloride or solutions containing traces of pectin, asked whether Dr. Clayton had observed any change in the optical properties of these crystals. Were they still isotropic as were cubic crystals or had they an optical activity? With regard to the two types of zinc oxide referred to by the president, he believed that the people responsible for putting these on the market made no claims for a change of surface activity so much as a change, definitely, of particle shape. In the case of zinc oxide for rubber manufacturer the particles were approximately spheres, whilst for paint manufacture they were in the natural form, giving points of weakness where the medium came into contact with the crystal. As to a change in the nature of the crystal surface and the possibility of occluded gas having a considerable effect on the wetting properties, he had been making some experiments with zinc oxide recently in which he had tried grinding in an edge runner mill, and the first thing he had noticed was that the bulk density increased considerably. The powder itself decreased in bulk to quite a small value, and he considered that the enhanced dispersion obtained when he incorporated the treated zinc oxide in oil was possibly due to the removal of a certain amount of occluded moisture or even occluded air.

Dr. CLAYTON replied that no work has been done on the optical properties of sodium chloride.

Mr. G. BOLTON-SMITH suggested, in connection with stabilisers, that the position gets very complicated with different pigments having different electrical charges with respect to the different types of medium in which they are ground. As an illustration, he mentioned stearated pigments and suggested that the alteration of the degree of polymerisation on the surface of the particles had a bearing on this particular point. He asked for the author's views with regard to stearated pigments and whether their polymerisation changed when using them mixed with pigments of a different degree of polymerisation, having regard to their surfaces and in media in which they did not normally amalgamate.

Dr. CLAYTON said he was not very clear on this point because it was rather foreign to his own sphere of work, but he would anticipate effects related to the mutual attraction or repulsion caused by the oriented molecular groupings around the particles.

Dr. J. O. CUTTER asked for information as to the best technique to use at the present time for the elucidation of this general problem. He believed it was agreed that when a material was adsorbed on a surface there was a mono-molecular layer, but, in addition, there was also a considerable amount of evidence of a further layer which was oriented with that mono-molecular layer. The paint industry set out to do what was a very difficult thing. The pigments which were used in the ordinary way—particularly synthetic pigments—were always precipitated from an aqueous medium and they were converted into a surface which, it was held, would become completely surrounded by a mono-molecular layer of a further material in any medium, and that medium was usually of an entirely opposite type to an aqueous one. Personally, he very much doubted whether there was any actual orientation or distortion of the lattice on the surface, and that it was largely a question of the formation of new cleavage planes directly in contact with that surface. Reference had been made to the Bartell cell and he was not disclosing anything when he said that work had been done on that to a very great extent on a sulphide pigment, and it had been found, as Dr. Clayton had said, that this pigment might display characteristics which were pre-determined by the previous material with which it had been in contact.

German Demand for Radium

Imports from Belgium

WITH the increased demand for therapeutical purposes, German consumption of radium has been increasing in recent years and is now estimated at approximately three grams per year. This figure, however, while an estimate by an authority, is not supported by data. Current stocks of radium in Germany are estimated at around five grams. Except for the recovery of small quantities from radioactive mineral springs, notably the curative springs at Bad Kreuznach in south-western Germany, all of Germany's requirements of radium must be imported from abroad. The bulk, estimated at 98 per cent. of the total, of Germany's radium imports is furnished by Belgium from radium works at Oole, near Antwerp. The remaining imports come from St Johanisthal, Czechoslovakia; official statistics show that Czechoslovakia in 1932 produced 3,750 mg. of radium, that domestic Czech sales amounted to 1,454 mg. and that 350 mg. were exported to Germany. Small quantities of radium are recovered from the silt, or mud, produced by the springs at Bad Kreuznach. About 20 tons of radioactive silt, or radio-barium, accumulate at these springs each year, and these deposits yield about 1.75 milligrams of radium per ton. Two leading concerns, the Radium Chemie A.G., Frankfort-on-Main; and the Allgemeine Radium A.G., Berlin, virtually control the German trade in imported radium materials, but during the past eighteen months the Degea A.G. (Auer Gesellschaft), Berlin, has entered the radium field and is now interested in importing radium-bearing ores.

Hydrogen Production by the Badische Process—II

Water Gas Production and Catalysis

In continuation of notes on the Economics of the Synthetic Manufacture of Ammonia, published in "The Chemical Age," October 5 to November 16 inclusive, the present series deal particularly with the design of the plant for the production of hydrogen by the Badische Process.

THE hydrogen plant divides itself into four main sections: (1) water gas production, (2) water gas catalysis, (3) removal of CO_2, and (4) purification. Each of these sections will be considered separately.

Quantity of Water Gas Required.

The average composition of the water gas for the purpose of these calculations can be taken as: H_2 48 per cent., CO 42 per cent., CO_2 5 per cent., N_2, etc., 5 per cent., which will be rather a lower average of hydrogen than may be aimed for. The quantity of methane in the water gas has been neglected; it should be kept as low as possible, but will depend on the quality of the coke used and on the temperature in the generators. It is formed from CO and hydrogen at a high temperature and anthracite or coke, which is not completely burnt will also produce larger quantities of methane than are desirable. With proper running the quantities should not be as much as 1 per cent. of the water gas.

After catalysis at 550° C., the composition of this can be obtained as follows:—

Let x be the quantity of steam (vols.) converted to hydrogen and CO_2 by the interaction with CO, and let three volumes of steam be added for every one volume of the water gas, then assuming 300 steam to 100 gas.

$$K = 0.23 = \frac{(300 - x)(42 - x)}{(5 + x)(48 + x)} = \frac{12{,}600 - 342x + x^2}{240 + 53x + x^2}$$

Whence $x^2 - 461x + 16{,}300 = 0$, and $x = 39$.

Hence, volume of CO remaining is three volumes in 400 vols. (300 steam + 100 gas) of issuing gas or 0.75 per cent. CO; after condensation of the steam the percentage would be

$$\frac{3 \times 100}{139} = 2.16\%\ \text{CO.}$$

or, assuming the catalyst to work at 90 per cent. efficiency, 2.4 per cent. CO.

The composition after catalysis would thus be about H_2 62.5 per cent., CO 2.4 per cent., CO_2 31.5 per cent., N_2 3.6 per cent., and 100 vols. of water gas becomes 139 vols. of catalysed water gas, containing 87 vols. of hydrogen.

Therefore the yield may be taken as 1.15 water gas : 1 hydrogen. There will be further losses in hydrogen during the subsequent operations of removal of CO_2 and CO; theoretically these should not amount to more than a few per cent., as will be seen, but in practice the losses may be considerably greater. A loss of 20 per cent. will be allowed for, so that the yield of water gas to hydrogen may be taken as $1.2 \times 1.15 = 1.38$ water gas : 1 hydrogen. Therefore to produce 8,540,000 cu. ft. of hydrogen per day there would be required 11,800,000 *cu. ft. of water gas* at 20° C.

Capacity of Plant.

Such a quantity of water gas would be provided by eight generators of specified type, with waste heat boiler plant (providing the steam for the generators from the waste heat of the water gas and blow gases). The proposal for 10 sets producing 15,000,000 cut. ft. per day would therefore suffice for the plant under consideration.

Quantity of Coke.

Assuming 40 lb. coke per 1,000 cu. ft. water gas, 12,000,000 cu. ft. would require

$$\frac{40 \times 12{,}000}{2{,}240} = 214 \text{ tons per 24 hours.}$$

or for the full plant allow

$$\frac{214 \times 15}{12} = 270 \textit{ tons coke handling capacity} \text{ per day.}$$

The thorough scrubbing of the gas is important. Any removal of CO_2 which is effected by the water scrubbing is all to the good. When producing a high percentage of hydrogen, the CO_2 percentage will be high and about one per cent. of this would be removed by the scrubbing. 5 per cent. in the resulting gas will be assumed.

Treatment of Water Gas.

At this stage removal of H_2S is unnecessary and inadvisable. The catalyst will convert CS_2 to H_2S, and so it is best to remove the whole of the sulphur compounds together *after* the catalysis. On the other hand, the gas must be very clean. Any tar fog or ethylene compounds should be removed, otherwise it appears the catalyst is carbonised, and loses its activity.

In experiments already carried out, the gas is passed direct from the blue water gas plant to a gasometer and is used without further purification for the catalysis; but the catalyst has not behaved very well with this gas and about 0.1 per cent. of unsaturated compounds are present. In this experiment the water gas has been taken through a superheater, which has been at a very considerably higher temperature than the converter. There has been a tendency to char such unsaturated compounds. This would not be the case on the large scale, as the gas would not be allowed to reach the conversion temperature until it passed into the converter. It is possible there may be traces of benzene, ethylene, etc., but it is probable that these in the presence of hydrogen would be converted to saturated compounds by the catalyst. But unsaturated substances producing tarry products or traces of tar fog in the original water gas would tend to carbonise the catalyst and destroy its activity. It is therefore important that these should be removed completely and that the quality of coke used should be constant and therefore come from the same source.

A washing with green oil would probably suffice to remove any traces of aromatic and unsaturated compounds, and tar fogs should be caused to coalesce by passing through a diaphragm tar fog saturator. It is probable an extra scrubbing may be necessary. The gas can then pass direct to two balancing gasometers and from there it can be boosted to the catalysers at about 2 lb. pressure.

Summary: Water Gas Production.

Generators (10 sets) producing 15,000,000 cu. ft. per day.
Coke handling plant for 270 tons per day.
Thorough water scrubbing and tar removal, but iron oxide boxes not to be installed in this section of the plant.

Investigations.

Effect of ethylenic compounds, etc., on catalyst.
Means of removal of traces of tar in the gas, and analysis of tar in gas.

Water Gas Catalysis

The water gas has next to be converted to hydrogen and CO_2 as far as possible, the equilibrium

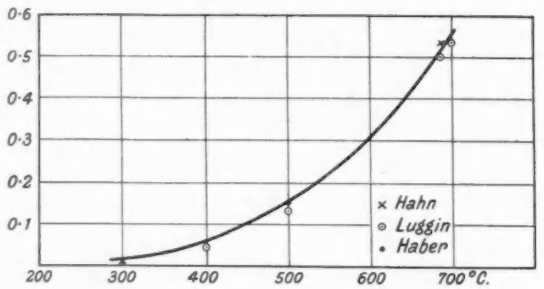
$$\frac{{}^{c}CO \times {}^{c}H_2O}{{}^{c}H_2 \times {}^{c}CO_2}$$

being set up under the agency of the iron chromium cerium catalyst. The extent of the conversion will depend obviously on the temperature, on the composition of the water gas, and on the quantity of the steam added.

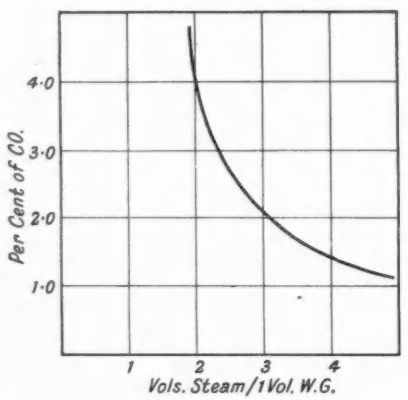
Quantity of Steam Required.

It is probable $2\frac{1}{2}$ vols. of steam would be sufficient to add per 1 vol. of water gas to obtain sufficient removal of the CO. Above such a quantity, further excess of steam only

reduces the percentage of CO by a small fraction, without adding more than a trace of hydrogen (see Graph I and Ia). The addition of 3 vols. will, however, be allowed for. The pressure of the steam in the catalysers will be taken as 16.7 lb. (absolute).



Wates Gas Equilibrium $K = \dfrac{[H_2O]\,[CO]}{[H_2]\;\;[CO_2]}$



Curve showing percentage of CO in gas issuing from convertors after removal of steam (temperature of conversion 550°C.)

Volume of Catalysed Water Gas.

11,800,000 cu. ft. water gas at 20° C. = 139 × 1,180,000
= 16,400,000 cu. ft. catalysed water gas.

Such gas will contain about 10,256,000 cu. ft. Hydrogen.
393,000 ,, ,, CO.
5,160,000 ,, ,, CO_2.
590,000 ,, ,, N_2 and methane.
16,399,000

11,800,000 cu. ft. = 492,000 cu. ft. per hour.
= 8,200 cu. ft. per min. at 20° C.
$= \dfrac{14.7 \times 8{,}200 \times 823}{16.7 \times 293} = 20{,}200$ cu. ft. at 550° C. and 2 lb. pressure per min.

Therefore, *volume of steam* added = 3 × 20,200 = 60,600 cu. ft. at 550° C. and 2 lb. pressure per min.

Density of superheated steam can be obtained as follows :—

$$D = \frac{1.684\ P}{t + 460} = \frac{1.684 \times 16.7}{1491}\ (t = 1{,}031F.^\circ)$$

= 0.018 lb. per cu. ft.

Therefore, 1 lb. = 55.6 cu. ft. at 550° C. and 2 lb. pressure. So that 60,600 cu. ft. will be $\dfrac{60{,}600}{55.6}$ = 1,090 *lb. per minute.*

= 29.2 tons per hour.
= 700 *tons per day.*
= (say) 100 tons coal, or $\dfrac{100}{8540}$ = 0.0117 T per 1,000 cu. ft. H_2.
= 2.8d. at 20s. per ton.

Volume of Gas Passing Catalyst at 550° C.

60,600 + 20,000 = 80,800 cu. ft. per minute.
= 1,350 cu. ft. per second.

Thermal Balance.

Before estimating the number of converters required it is necessary to consider the question of thermal economy.

Eater Gas : 11,800,000 cu. ft. = 8,200 cu. ft. per minute at 20° C. and normal pressure.
= 8,200 × 0.0425 = 348 lb. per minute.

Heat required to raise 348 lb. of water gas to 550° C. from 20° C.
= 530 × 0.428 × 348 = 79,000 C.H.U. per minute.

Heat required to raise 1,090 lb. of steam to 550° C. from 104° C.
= 446 × 1,090 × 0.47 = 229,000 C.H.U. per minute.

Total 308,000 C.H.U. per minute.

Density :—

H_2 . . .	$\frac{48 \times 2}{100} = 0.96$
CO . . .	$\frac{42 \times 28}{100} = 11.75$
CO_2 . . .	$\frac{5 \times 44}{100} = 2.20$
N], etc. . .	$\frac{5 \times 28}{100} = 1.40$
	16.31

Therefore (at 20° C.) 385 cu. ft., weigh 16.31 lb., or, 1 cu. ft. weight, 0.0425 lb.

Specific Heat of Water Gas (mean) :—

0.48 × 2 × 3.4	= 3.26
0.42 × 28 × 0.244	= 2.86
0.05 × 44 × 0.236	= 0.52
0.05 × 28 × 0.24	= 0.34
	6.98

16.31 = 0.428

The heat given out by the reaction (at 560° C) is 9,000 C.H.U. per 28 lb. of CO converted.

(0.39 × 8,200) cu. ft. of CO are converted per minute,

$= 3{,}200$ cu. ft. $= \dfrac{3{,}200}{385} \times 28 = 233$ lb. per minute.

Therefore, heat available from reaction $= \dfrac{9{,}000 \times 233}{28}$
= 74,800 C.H.U.

(Note : Radiation loss from converters would be about 17 × 1,000 C.H.U. per minute = 17,000 C.H.U.)

The products of catalysis cannot leave the interchanger at much less than 100° C., because the partial pressure of the steam will be

$\dfrac{400 - 139)}{400} \times 16.7 = 10.9$ lb.,

and steam would condense at this pressure at 92.5° C.

So that *heat available for return* would be :

450 × 0.47 × 1,090 = 230,000 C.H.U. per minute.
450 × 0.428 × 348 = 67,000 ,, ,, ,,
297,000 ,, ,, ,,

Therefore, *efficiency of interchange* for autothermic working must be given by $\dfrac{\text{heat required}}{\text{available heat}}$

$$= 100 \times \frac{(308{,}000 - 74{,}800)}{297{,}000} = \frac{100 \times 233{,}200}{297{,}000} = 78.5\%.$$

or with radiation loss approximately included,

$$\frac{100 \times (233{,}200 + 17{,}000)}{297{,}000} = 84\%.$$

It is obvious from this that large catalyst units would be necessary, if preheating is to be avoided. It has been indeed stated that the Germans use units of 500-1,000 C.H.U. or, say, 30,000 cu. ft. per hour capacity each.

The design of converter should be such that the catalyst should be placed together as a rather large mass, and a very efficient interchanger should be provided.

Number of Catalyst Units.

The size of the plant required can, however, in the meantime, be considered from the data already available from previous experiments. These show that it is safe to assume

a conversion of 500 cu. ft. of gas per hour (estimated on the hydrogen contained in the resulting gas) by 1 cu. ft. of catalyst at convenient velocities of flow.

The *volume of hydrogen* is 10,256,000 cu. ft. per 24 hours = 427,000 cu. ft. per hour.

Therefore, $\frac{427{,}000}{500}$ = 854 cu. ft. of catalyst space is required.

Assuming the catalyst chamber to have a capacity similar to that of a Grillo converter (*viz.*) 10 ft. × 6 ft. 6 in.; and that the velocity of flow past the catalyst is 30 ft. per second. The size of catalyst grain being (about) $\frac{5}{8}$ in., the net area will be 0.0775 the gross area.

$$\text{Gross area} = (6.5)^2 \times .780 = 33.2 \text{ sq. ft.}$$
$$\textit{Net area} = 2.58 \text{ sq. ft.}$$

The *volume of gas* flowing through all the converters is 80,800 cu. ft. per min. = 1,350 *cu. ft. per sec.* Therefore, the number of converters (n) required is given by:—

$$\frac{1{,}350}{n \times 2.58} = 30 \text{ ft. per second (assumed velocity).}$$

$$\text{or, } n = \frac{1{,}350}{2.58 \times 30} = 17.4$$

Size and Arrangement of Converters.

The depth of catalyst necessary would be about $\frac{854}{33.2}$ = 25.7 ft.

17.4 converters = 70 trays, so that depth on each tray would be

$$\frac{25.7 \times 12}{70} = 4.4 \text{ in.}$$

It is thus clear that an installation of 17 converters would be more than enough to provide, because the fuller the converters the better the conservation of heat. We shall assume a slightly greater velocity and a *number of converters* 15 to deal with the gas. Each converter would then deal with

$$\frac{8{,}500 \times 63}{15} = 32{,}800 \text{ cu. ft. of water gas per hour}$$

this is about the size required. The converters could probably be shorter, say 6 in. between the trays instead of about 12 in., thus reducing the total dimensions to 8 ft. × 6 ft. 6 in. The interchanger should be incorporated within or situated close to the converter; or a combination of internal and external interchangers.

The converters could be arranged in two rows of eight (or allowing 2½ spares for each row, two rows of 20). The volume of water gas to each row would be 5,900,000 cu. ft. per day = 4,100 cu. ft. per minute and the quantity of steam = 545 lb. of steam per minute. The two mains for the water gas from the booster plant would be about:—

$$\frac{4{,}100}{60 \times 60 \times 0.786} = 1.45 = 1.2 \text{ ft.}$$
$$= \text{(say) 15 in. diameter.}$$

but would decrease in diameter as the gas is taken off to the several converters.

The steam could be brought at any convenient pressure, but the pressure should be reduced to 2 lb. before mixing with the water gas, which mixture should be made complete in the interchanger. The gas and steam should be metered separately by flow rate indicators; the steam before reduction of pressure.

Quantity for Each Converter.

The weight of steam entering each converter is

$$\frac{1{,}090}{15} = 72.6 \text{ lb. per minute,}$$

and of water gas

$$\frac{8{,}200}{15} = 546 \text{ cu. ft. at } 20^\circ \text{ C.} = 23.2 \text{ lb. per minute.}$$

The heat of reaction in each converter would be

$$\frac{74{,}800}{15} = 4{,}990 \text{ C.H.U.}$$

If the temperature of gases leaving converter is 550° C. and the loss by radiation is 1,000 C.H.U. per minute. The temperature of the gases entering the converter from the interchanger would be obtained as follows:—

$$\text{Heat available} = 3{,}990 \text{ C.H.U.}$$
$$= (23.2 \times 0.428) + (72.6 \times 0.47)(550 - t)$$
$$(550 - t) = \frac{3{,}990}{9.95 + 34.1} = 90.5$$
$$\text{or, } t = 460^\circ.$$

The gases should therefore enter the converter at 460° C.

The Evaporation of Water from Surfaces

A Search for Data to Improve Modern Drying Plant

AN investigation of outstanding importance on the evaporation of water from plane and cylindrical surfaces was reported by Mr. R. W. Powell, B.Sc., and Dr. Ezer Griffiths, F.R.S., in a paper read at a meeting of the Institution of Chemical Engineers on November 20, Dr. F. S. Sinnatt (vice-president) in the chair. This investigation dealt with the underlying physical basis of the phenomenon of the evaporation of water from a saturated surface with special reference to the contribution of each of the elements constituting the particular surface.

From general considerations, said the authors, it is to be anticipated that the rate of evaporation should depend on (i) the geometrical form of the surface, (ii) the nature of the air flow over the surface, (iii) the velocity of the air relative to the surface, and (iv) the difference between the saturation pressure corresponding to the temperature of the surface, and the actual vapour pressure in the air stream. In the case of an unsaturated surface the rate of evaporation also depends on the resistance to the flow of water from the interior of the solid to the surface.

Although a considerable amount of experimental work has been carried out in the past by various workers, the formulæ expressing their results differ appreciably, so it was decided to conduct a further investigation with a view to obtaining information on the one fundamental aspect of the problem which had hitherto been neglected—namely, the contribution of each of the elements which build up the surface.

In the present case two simple geometrical forms are considered, the elements constituting (1) a plane horizontal surface and (2) a vertical cylinder. The experiments were carried out in an open circuit wind tunnel, the evaporating surface being maintained at a uniform temperature by means of a number of strip heating elements which are independently controlled.

A photograph of the wind tunnel is shown in Fig. 1. It consisted of a hollow wooden structure 330 cm. in length and of 54 cm. square cross-section, flared at one end to 100 cm. square cross-section, the length of the flare being 60 cm. A suction fan driven by a 0.25 h.p. motor was mounted at the other end, and could produce a maximum wind velocity of about 300 cm. per sec. A vertical cylinder was mounted in position in the working section of the tunnel. An exploration of the wind speed at various points in a plane near this section had shown that the air velocity was constant to within about 4 per cent. over the working area of the tunnel.

The plane surface used in these experiments (Fig. 2) was mounted in the centre of the wind tunnel midway between

the ceiling and floor, and presented the appearance of a shallow box about 1 in. in depth which stretched from side to side of the wind tunnel. The edge facing the wind was fitted with a streamlining nose. The actual experimental surface consisted of a tightly stretched linen sheet, the borders were painted with durofix, which restricted the wetted portion to an area 18.2 cm. wide, transverse to the direction of the wind, and 24.3 cm. long. The linen cover extended over the streamlining nose, and the rear edge of the panel, and was glued to the underside. The two edges parallel to the wind stream were held in position by strip guard heaters, which served to prevent any loss of heat laterally from the surface under investigation. Beneath the linen, nine water-tight parallel strip heaters had been cemented to the panel by means of bakelite solution. The two heaters situated nearest to the upstream edge were about 1.5 cm. wide, and the remainder had a width of a little under 3 cm. Each was approximately 18 cm. long, the longer side being parallel to the leading edge of the panel. Current and potential leads to each of these heating elements, and water feed tubes, passed along the underside of the panel. The box itself was well lagged to minimise heat loss by conduction.

During the preliminary experimental adjustments water was fed at a steady rate from a vessel of known volume mounted about 6 ft. above the tunnel. This vessel, moreover, was fed from a larger vessel by a syphon and so remained full of water for a considerable time. The rate of supply was adjusted to maintain a slow uniform drip from the overflow tube, and the water was preheated to a temperature equal to that of the wet surface. After adjusting the currents in the heating elements to bring the surface of the cloth to a uniform temperature, the syphon was removed, and the time taken to supply the known volume of water determined. The amount of water collected as excess during this interval was also measured, and the rate of evaporation from the whole surface determined from the difference between these two quantities. Measurements were also made of the current and voltage across each heater, the temperature, humidity and velocity of the air a short distance upstream of the model.

This experiment was carried out for various surface temperatures, which gave vapour pressure differences between the surface and the ambient air ranging up to about 50 mm. of mercury, and at four wind speeds of approximately 60, 115, 180 and 260 cm. per sec. These wind speeds were measured by means of a rotating vane anemometer situated upstream of the surface under investigation, and in an unrestricted section of the tunnel, a correction of +5 per cent. being applied to the observed value to allow for the blocking effect of the surface and to give the approximate true air velocity along the surface.

From the results of experiments on the rate of evaporation from a plane horizontal surface subjected to a tangential wind it is concluded that this rate of evaporation may be represented by the equation

$$E_{lb} = A l^n b^m (p_w - p_a)^s (1 + Bu^r)$$

where E_{lb} is the total evaporation from an area of length l and width b, u is the velocity of the wind incident tangentially to the surface and perpendicular to the side of length b; the indices m, n, r and s are probably functions of u and of the size of the surface, whilst A and B are constants.

For values of u exceeding 60 cm. per sec. the experiments have shown s to be unity; the values of m and n increase with increase in u, and may also be functions of l and b. According to the present experiments an equation which represents the total rate of evaporation from a horizontal plane rectangular surface, presenting a side of not less than 20 cm., to a tangential wind stream ranging in velocity from 100 to 300 cm. per sec., *is*

$$E_{lb} = 2{\cdot}12 \times 10^{-7}\, l^{0{\cdot}77}\, b\, (p_w - p_a)\, (1 + 0{\cdot}121\, u^{0{\cdot}85})$$

At lower velocities, or for relatively narrower surfaces, an approximate equation which might be employed is

$$E_{lb} = 4{\cdot}3 \times 10^{-7}\, l^{0{\cdot}72}\, b^{0{\cdot}8}\, (p_w - p_a)\, (1 + 0{\cdot}121\, u^{0{\cdot}85})$$

The most interesting result established by the present investigation has been that showing the manner in which the

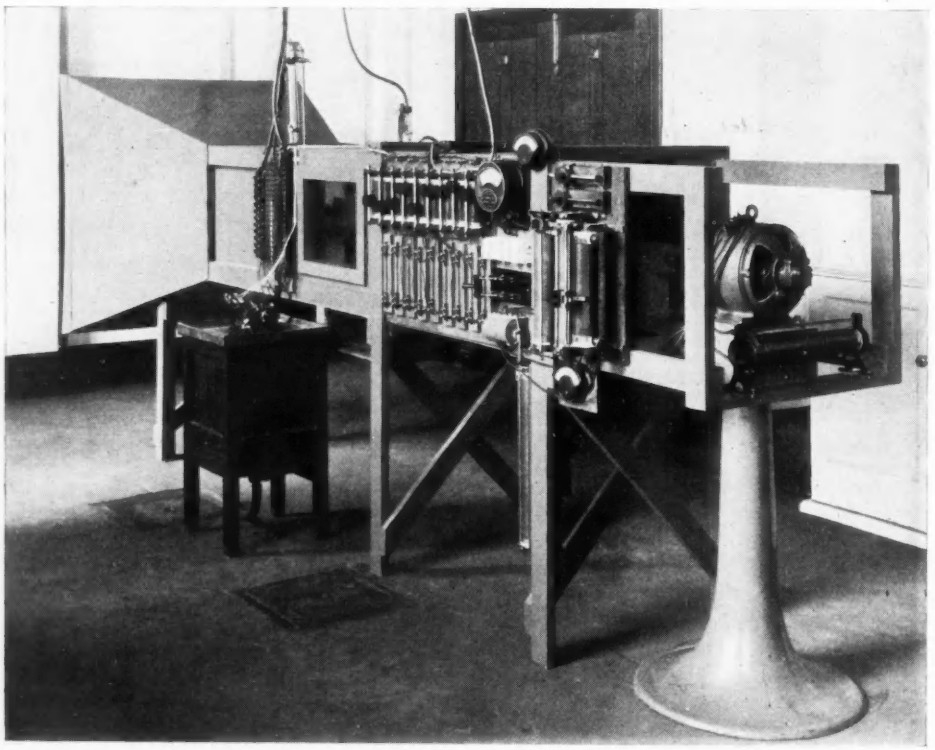


Fig. 1. General view of wind tunnel and control gear.

evaporation depends on the dimensions of the surface. So far as the authors are aware, their own experiments just mentioned are the only laboratory tests which have been made to determine the effect of size of surface on the rate of evaporation in a stream of air, and the present experiments constitute the first attempt to study the distribution of the rate of evaporation over a plane water surface maintained at a uniform temperature. It is found that the rate of evaporation from an element of the surface decreases as the position of that element becomes further removed from the leading edge, the mean rate of evaporation from a strip 1.0 cm. wide at the front of the experimental surface being about 2.6 times as great as that from a similar strip at a distance of 23 cm. from the front.

This variation in the rate of evaporation with the dimensions of the surface appears to have been overlooked by earlier experimenters, who have often expressed their observed results for the rate of evaporation from a surface of limited area so as to give the rate of evaporation from unit area.

Experiments of a similar nature to those described for the plane surface were carried out for a sectional cylindrical surface, the measured wind velocity having been increased by about 16 per cent. to allow approximately for the blocking effect of the cylinder in the tunnel. Here it was found that the rate of evaporation in grams per sec. per cm. length of the cylinder could be fairly well represented by

$$E = 1{\cdot}24 \times 10^{-6}\ V^{0{\cdot}7}\ (p_w - p_a).$$

the index of V being a mean value, as it tends to decrease slightly with increase in V.

The authors gave an account of measurements which were made to determine the rate of evaporation from saturated surfaces, maintained at uniform temperatures ranging up to 20° excess above the air, when subjected to the influence of steady winds ranging in velocity from 60 to 260 cm. per sec.

Two geometrical forms are studied in detail, one a horizontal plane measuring 18.2 cm. wide and 24.3 cm. long, and the other a vertical cylinder 18.0 cm. in height and 27.1 cm. in circumference, in both of which the temperature of the surface is controlled by a number of separate strip heaters. This arrangement enabled an estimate to be made of the variation in the rate of evaporation over the area of the surface. It being found that in the case of the plane surface subjected to a tangential wind there is a decrease in the rate of evaporation as the distance from the leading edge increases, whereas, in the case of the cylinder mounted with its axis perpendicular to the wind direction, the rate of evaporation assumes maximum values at the front and rear surfaces and decreases to minimum values at the sides. Mention is made of the influence of cylinder diameter on the rate of total evaporation.

For plane surfaces at least 20 cm. wide and for wind speeds of at least 100 cm. per sec. the rate of total evaporation in grams per sec. is represented by

$$E_{lb} = 2{\cdot}12 \times 10^{-7}\ l^{0{\cdot}77}\ b\ (p_w - p_a)\ (1 + 0{\cdot}121\ u^{0{\cdot}85})$$

where l and b are the length and width of the surface respectively, u is the air velocity, and $(p_w - p_a)$ is the vapour pressure difference between the saturated surface and the air at a distance, measured in mm. of mercury. For narrower surfaces and lower air velocities, the increased evaporation near the sides of the surface becomes appreciable, and the rate of evaporation is no longer approximately proportional to the width.

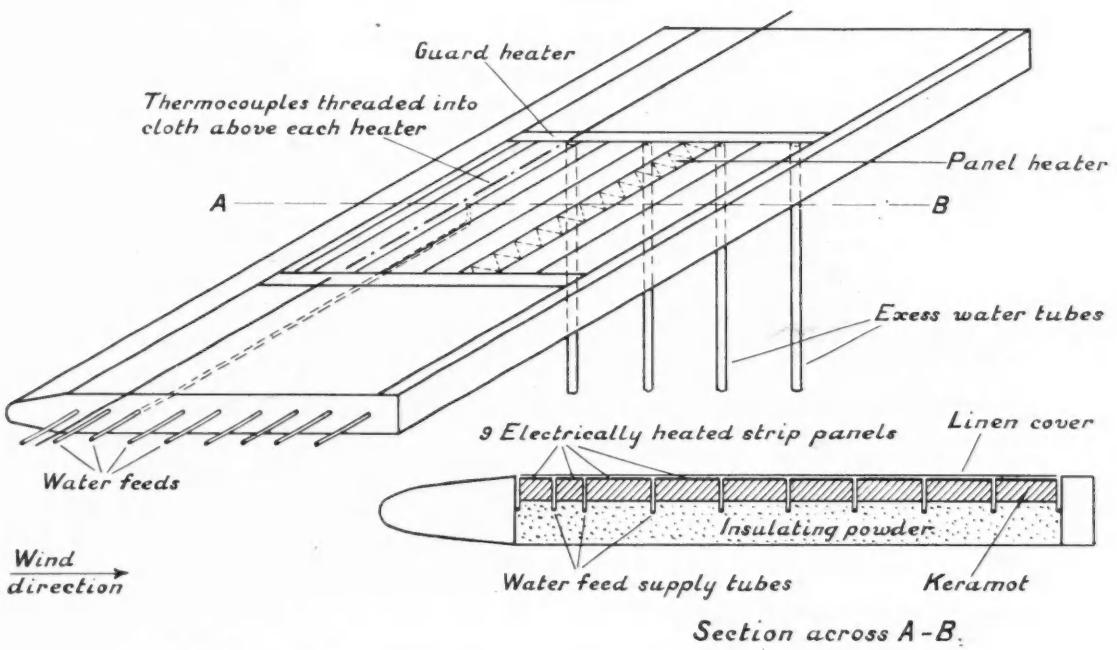


Fig. 2. Apparatus for measurement of evaporation from a plane surface.

The rate of total evaporation is found to be proportional to $l^{0{\cdot}77}$, and this result is compared with the theoretical values of $l^{0{\cdot}5}$ and $l^{0{\cdot}89}$, predicted by H. Jeffreys ("Phil. Mag.," 1918, *35*, 270) and O. G. Sutton ("Proc. Roy. Soc.," 1934, *146*, 701) respectively, and with existing experimental data. It follows that the rate of evaporation is not proportional to the area of the surface and that allowance for this should be made in comparing the results of various experimenters. This is attempted but considerable variations still remain between the rates of evaporation determined by different observers.

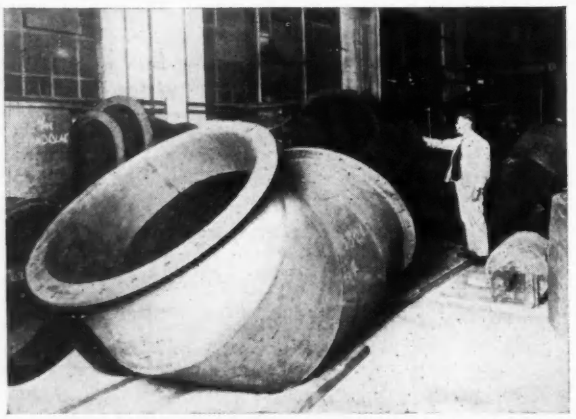
Since in most of the previous work on the subject the water surface has been bordered by a pan rim, experiments are also described in which the effect of a ridge, projecting slightly above the plane of the surface and running parallel to the leading edge, has been studied. An analysis is also made of the relative amounts of heat transferred from the surface by evaporation, radiation and forced convection. For surface temperatures of from 25 to 45° C., and air at a temperature of 20° C. and relative humidity of 60 per cent., the heat transfer due to evaporation is between 70 and 80 per cent. of the total heat loss.

Rubber as an Anti-Corrosive Medium

How the Rubber Manufacturer is Assisting the Plant User

THE use of ebonite and rubber as an anti-corrosive medium is by no means a new idea, but specialised knowledge of compounding and application has resulted in progressive development during recent years and rubber- and ebonite-lined equipment is now accepted as standard practice. Such equipment has practically superseded lead and bitumen linings and has a distinct price advantage over acid resisting metals.

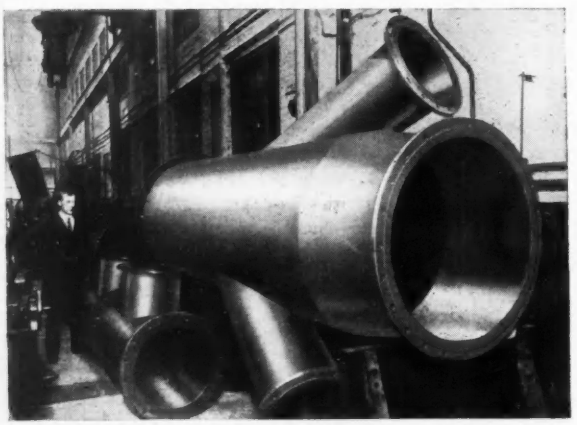
Metal storage vessels normally ready for scrapping can in many instances be fitted with a rubber lining in situ and



Piping lined with Dunlop Anti-Corrosion Rubber has been supplied to Synthetic Ammonia and Nitrates, Ltd.

continue to give many useful years of service, as the thickness of metal no longer represents the life. This applies equally to new lined equipment, where the thickness of metal may be reduced to a minimum, thus nullifying to some extent the cost of the rubber lining.

New vessels primarily designed for rubber lining should



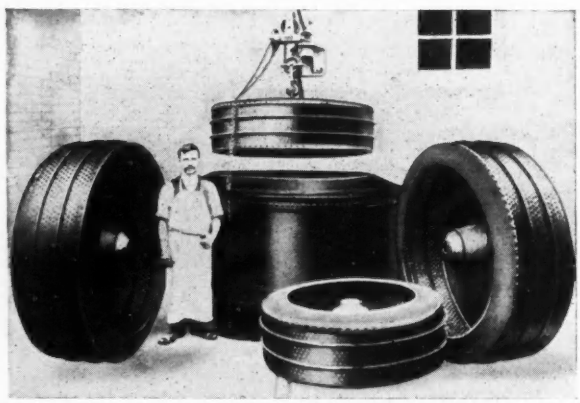
Dunlop Anti-Corrosion Rubber is also used for many types of pipework.

be of welded construction, having all corners slightly radiused and welds ground reasonably smooth. If made of cast iron, the metal should be of good quality and as free as possible from porosity; any unavoidable blow-holes should be broken open and not filled with compound. Cylindrical, vertical and horizontal tanks should have one end flanged and detachable to allow the operative to enter the vessel, the usual manhole being insufficient.

Rubber and ebonite linings being free from corrosive residual deposits will not contaminate products of high purity. Being practically non-absorbent they are of great value in the lining of dye-becks, enabling a quick change of colour to be made by simply washing down, whereas wooden dye-becks are usually retained for one colour only. Hard rubber or ebonite, whilst more resistant to acids than soft rubber, does not possess the abrasion resistant qualities of the latter, and tanks and agitators, pumps, pipes, etc., dealing with acid and abrasive slurries may be lined with specially compounded rubber to great advantage. Soft rubber may be applied to vessels in situ, vulcanisation being completed by means of boiling water.

Hard and fast rules regarding the chemicals to which ebonite and rubber are resistant, cannot be clearly defined, as much depends on the concentration and temperature attained, and it is advisable to give the fullest details to enable the rubber manufacturer to specify the most suitable quality and grade of rubber for the duties involved.

Solid ebonite flanged pipes may be supplied in lengths up to 9 ft. and from ½ in. to 3 in. bore; the flange diameter and drilling conforming to the engineering standards. Pipes of 1 in. diameter and less may be supplied screwed in lieu of



Hydro-Extractor Cages for handling acid crystals are lined with Dunlop Acid-Resisting Rubber.

flanges, suitable screwed connections being available. Such fittings are capable of withstanding a pressure of 75 lb. per sq. in. when dealing with cold or slightly warm liquors.

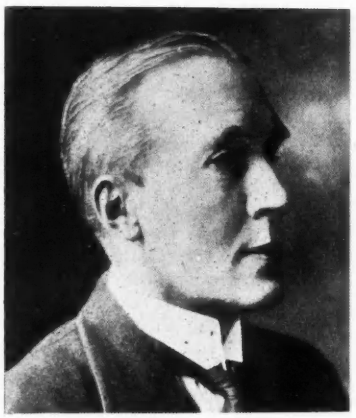
Ebonite pipes, in relation to steel pipes, require considerably more care in handling and supporting as sagging is liable to take place at temperatures exceeding 70° to 80° C. Where cold or slightly warm liquors are used, they will give every satisfaction. To overcome the disadvantages referred to, ebonite rubber-lined steel pipes, bends, etc., have been introduced and standard flanged pipes from 1 in. bore upwards and in lengths of 4 ft. to 15 ft. can be supplied. The lining is not merely a loose inserted tube, but is in contact with and vulcanised to the pipe bore and will not collapse. Such pipes have all the virtues of solid ebonite piping with the strength of steel and may be used at much higher pressures and temperatures.

The loss of head due to friction is considerably lower in a rubber-lined pipe than in new mild steel pipes, and it remains constant, whereas frictional losses steadily increase in steel pipes as corrosion sets in.

Buckets, jugs, measures, etc., for small quantities of liquor are supplied for capacities from ½ pint to 3 gallons. The "Nerflex" type of bucket has insertion embedded in the walls, resulting in a flexible and practically unbreakable utensil, capable of withstanding rough usage; a special feature of this bucket is the white lining which enables foreign matter or a change of colour to be quickly detected.

Personal Notes

PROFESSOR F. G. DONNAN, professor of chemistry in the University of London and director of the chemical laboratories, University College, has been elected a foreign member of the Division for Chemistry of the Royal Physiographical Society of Lund, Sweden.



Professor F. G. Donnan.

MR. H. B. ALLEN, metallurgist of the Henry Dosston Co., Philadelphia, and member of the board of managers of the Franklin Institute for several years, has been elected director of the Museum of the Franklin Institute.

LIEUT.-COLONEL HUGH LLOYD HOWARD, a director of Howards and Sons, Ltd., has been honoured by the King by the award of the Territorial Efficiency Decoration.

DR. P. C. C. ISHERWOOD, who has been a director of W. J. Bush and Co., Ltd., since 1915, has been appointed joint managing director of the company.

MR. F. J. KITSON, of Westwood, Leeds, an ex-Lord Mayor of Leeds, and chairman of Monk Bridge Iron and Steel Co., Ltd., Leeds, died on November 19 at the age of 74.

MR. WILLIAM MACKAY, fuel chemist of the Aargam Steelworks, Port Talbot, Glam., was killed last week by a box which fell from a charger crane at the works.

MR. A. L. FOSTER, chairman of Blackwater Mines, Consolidated Goldfields of New Zealand, and of the New Zealand Crown Mines Co., left £18,541, with net personalty £13,224.

PROFESSOR J. F. THORPE gave an address to the Aberdeen and North of Scotland section of the Institute of Chemistry at the Marischal College on November 21. His subject was "Careers which chemists may pursue."

DR. H. W. DUDLEY, Ph.D., F.R.S., biochemist at the National Institute for Medical Research and formerly lecturer in biochemistry at Leeds University, who died on October 3, aged 47, left property of the gross value of £8,224 (net personalty £8,066).

MR. A. E. MARSTON, Ph.C., has been appointed assistant pharmacist to the Birmingham Children's Hospital. He was trained at the Birmingham Technical College, and was awarded the Genard Gold Medal for the best work on the two years' course.

SIR A. M. PALMER, who died on August 9, left £31,480, with net personalty £26,268. Sir Alfred was chairman of the Bede Metal and Chemical Co., Ltd., and a director of John Bowers and Partners, Ltd., and the Marley Hill Chemical Co., Ltd.

MR. ROBERT STIRLING BROWN, ex-Provost of Pollokshaws, who died last week, aged 81, began work as a boy in Cochrane's Bleachworks. He studied the bleaching trade in all its branches and gained wide experience in a number of works in Scotland, England and America. Returning to Pollokshaws 43 years ago, he took over Cochrane's works, then a small concern, and founded the firm of Brown and Adam, bleachers and dyers, Riverbank Works, and made it one of the leading businesses of the kind in the country. In 1919 the firm was converted into a private limited liability company, with Mr. Brown's five sons in the business.

MR. J. C. AIKMAN, a director of Tingens and Unilevers, died in Scotland on November 20, aged 65.

MR. R. J. HOPE, chairman of Consolidated Tin Smelters, Ltd., left £11,953.

SIR F. C. MEYER, vice-chairman of De Beers, who died on October 19, aged 49, left gross estate of the value of £226,901 (net personalty £154,785).

MR. F. W. RICKETT will speak on "Oil: By an Onlooker," at the monthly luncheon of the Oil Industries Club, to be held on December 3 at the Hotel Metropole, where he will be the chief guest.

DR. C. E. K. MEES, vice-president in charge of research and development in the Eastman Kodak Co., Rochester, U.S.A., will deliver six lectures at the Royal Institution, commencing on December 28.

MR. L. C. M. AMERY has been appointed chairman of directors of Gold Exploration and Finance Co. of Australia, Ltd. The company is really a merger of the Australian interests of Austral Trusts, Ltd., Central Mining and Investment Corporation, Ltd., Imperial Smelting Corporation, Ltd., New Zealand Goldfields, Ltd., Union Corporation, Ltd., and the Zinc Corporation, Ltd.

Dr. Ernest Goulding Retires

Thirty-Nine Years' Service at the Imperial Institute

DR. ERNEST GOULDING, D.Sc., F.I.C., F.C.S., vice-principal of the Plant and Animal Products Department of the Imperial Institute, has retired on reaching the age limit. His connection with the Institute extended over a period of thirty-nine years, and during that time he took an important part in the Institute's scientific and technical work on Empire raw materials, as regards both laboratory investigations and intelligence services. Since 1923 he was also responsible for the editing of the "Bulletin of the Imperial Institute."

Dr. Goulding was a recognised authority on fibres, and his work on this subject has covered a wide diversity of fibrous materials of Empire origin. Reference may be made to the leading part which he took in the early investigations of Empire-grown cottons carried out at the Imperial Institute in the pioneer stages of cotton cultivation in the Colonies. He acted as secretary to the Imperial Institute Advisory Committee on Vegetable Fibres from its formation in 1926, and in this capacity undertook important work on the extension of the use of Empire-grown fibres, both for marine cordage and for other purposes.

Dr. Goulding's activities brought him into contact with many technical experts, official and unofficial, from all parts of the Empire, who will share the regrets felt by his colleagues at the termination of his long service at the Imperial Institute.

CANADA'S PRODUCTION LAST YEAR of new platinum and other platinum group metals totalled 200,162 fine ozs., valued at $6,190,045, as compared with 55,795 fine ozs. ($1,502,633) in 1933. The output of platinum metals in Canada comes almost entirely from the copper-nickel ores of the Sudbury district in Ontario, and the refining is accomplished in European metallurgical plants. Relatively small amounts of platinum are also recovered annually from stream gravels in British Columbia. Last year's production included 116,230 fine ozs. of platinum, valued at $4,490,763, of which 53 ozs. ($2,051) was the product of British Columbia. The production of platinum, rhodium, iridium, etc. (all from Ontario) totalled 83,932 fiine ozs. ($1,699,282). Last year's exports of platinum metals totalled 133,482 fine ozs. ($5,198,691), the metal being almost entirely exported in the form of concentrates.

Notes and Reports from the Societies

Society of Chemical Industry

Newcastle Section : Artificial Radioactivity

SOME important features of the new science of artificial radioactivity were dealt with by Professor F. Paneth, of the Imperial College of Science and Technology, London, in an address on "Artificial Radio-Elements," delivered to the Newcastle Section of the Society of Chemical Industry on November 22.

The production of artificial radio-elements, said Professor Paneth, was the newest development of the old science of alchemy. It was of special interest for the chemist as up to the present the quantities produced by artificial transmutation were too small for a purely chemical examination; if, however, the newly-formed elements were radioactive the much higher sensitivity of electrometric apparatus could be used for a study of their chemical properties, and in this new field the collaboration of the chemist with the physicist was as necessary and as fruitful as in the realm of the natural radioactive elements. Artificial radio-elements could be produced in many ways; by bombarding the elements with various kinds of rays of radioactive substances; with hydrogen or deuteron particles accelerated by electric fields; with X-rays; with neutrons. The efficiency of neutrons in transforming elements depended largely on their velocity and was in most cases much increased by slowing down the neutrons by collision with hydrogen atoms.

Professor Paneth showed experiments to demonstrate the activation of fluorine, rhodium, and silver by fast and slow neutrons, and the decay of the artificial radio-elements produced. A few elements, he said, possessed a special facility for absorbing slow neutrons; the neutron-nucleus collision cross sections of the elements boron, cadmium and gadolinium exceeded those of other elements by a factor of about 300, 3,000, and 30,000 respectively.

Among the many interesting features in the new science of artificial radioactivity were the creation of at least one new radioactive series and the production of elements of higher atomic number than uranium. On the practical side it was worth mentioning that the artificial radio-elements might be used in the same way as the natural ones as indicators in the study of many chemical, physical, and biological problems; for example, the phosphorus metabolism in rats had recently been investigated by this method. The ease with which, throughout the periodic system, elements can be experimentally transmuted, Professor Paneth said, goes far towards clarifying our ideas about the way in which the creation of the natural radioactive elements as well as of the stable elements has taken place.

Building Materials Group : Properties of Clay Soil

AN interesting paper on "The Physical Properties of Clay Soils and Some Aspects of Their Mechanical Behaviour" was read before a joint meeting of the Road and Building Materials and Plastics Groups of the Society of Chemical Industry, in London, on November 19, the author being Mr. L. F. Cooling, of the Building Research Station.

Mr. Cooling described various aspects of clay, including its classification and constitution and proceeded to indicate methods by which its physical properties could be characterised. Particle size distribution, plasticity, shrinkage, water relationships, mechanical behaviour, compressibility, and resistance to lateral movement were reviewed, and the value of the Atterberg technique in the determination of many of these factors was illustrated in a number of typical slides. The influence of the structure of clay soils on such problems as settlement of buildings was dealt with, and the lecturer described methods of sampling and testing used at the Building Research Station, Watford.

Institute of Chemistry

Scottish Sections : Celebration of 50th Anniversary

THE 50th anniversary of the Institute of Chemistry as a chartered corporation was celebrated by the Scottish Sections on November 22 at a dinner in the North British Station Hotel, Edinburgh, when Dr. Birkett Wylam presided.

Proposing the toast of "The Institute of Chemistry," Mr. T. M. Cooper, K.C., M.P., said he was astonished to find, on looking back over the last 50 years, an amazing disrespect for antiquity and a propensity in recent years to overturn the foundations of their science on the slightest provocation.

The Chairman, in reply, said this year had seen an important event in the annals of the Institute and in the history of chemistry in the arrangement for some collaboration between the three great societies of chemistry. He hoped the collaboration would become co-operation with other branches of science like physics, engineering and medicine, so that there might be a solid body of scientific opinion exercising power in the land.

Other speakers included Professor J. F. Thorpe, president of the Institute, Sir Hugh Arthur Rose, Commissioner for Special Areas in Scotland, Sir W. W. McKenzie, secretary to the Scottish Education Department, and Dr. R. F. Gordon, chairman of the Glasgow Section.

Liverpool Section : Science and Tobacco Manufacture

"THE Scientific Aspect of Tobacco Manufacture" formed the subject of an address given by Dr. H. H. Evers, chief chemist of the British American Tobacco Co., Ltd., before a joint meeting of the Liverpool Sections of the Institute of Chemistry and the Society of Chemical Industry, on November 21. Mr. B. D. W. Luff, chairman of the local section of the Institute, presided. Dr. Evers pointed out that there were fifty species of tobacco throughout the world, but of these only two were of real commercial importance. After describing the various stages of tobacco cultivation, the speaker dealt with the processes involved in manufacturing cigarettes and smoking tobacco in particular. Dealing with the influence of soils, fertilisers and climate on the growth of the plant, he gave an account of the investigations being carried out at research and experimental stations in different parts of the world, and more particularly in the United States and Russia.

The curing process to which ripe tobacco was subjected was primarily a drying process in which a series of complex chemical changes, as yet imperfectly understood, occurred in the leaf. The extent of these changes depended entirely upon whether the tobacco was flue-, fire- or air-cured. Little or no heat was employed in air-curing, the tobacco being dried under natural conditions and requiring on the average nearly two months to complete. This class of tobacco was largely used in the manufacture of "toasted" or blended cigarettes for the American market. Turkish tobacco was sun-cured. Flue-curing, in which the heat was conducted through flues to the leaf hung in the curing barn, was the most modern and scientific method of curing and was invariably employed throughout the world for the production of high-class cigarettes and smoking mixtures. Temperature and humidify had to be carefully controlled, particularly in the early stages of chemical change, otherwise the tobacco did not acquire the sweet aroma and bright yellow colour desired by the trade.

Leaf was sorted by the buyer or manufacturer into types and grades according to colour, texture and size of leaf, to ensure uniform blending. Within recent years, however, methods for the classification of tobacco by chemical means had attracted the keen attention of the industry and extensive research was gradually establishing a definite relation between quality and chemical composition.

Nicotine was important for its physiological action on the nervous system and it was generally accepted that a high percentage of this constituent indicated a rank quality. This was true to some extent, but tobacco containing large quantities of nicotine also contained large amounts of gum and resin which, in conjunction with the nicotine, were responsible for the ill-effects of excessive smoking. Generally speaking, the best tobaccos should have between 1 per cent. and 2 per cent. of nicotine. Tobacco without nicotine was as insipid as whisky without alcohol and a certain proportion of nicotine was necessary for the full enjoyment of the fragrant weed.

The services of the chemist had been invaluable in preparing analytical specifications and introducing new types of cigarettes, papers, wrapping papers, flavours and sweetening materials, and also in the investigation and standardisation of adhesives for all purposes. Processes had been evolved for the preservation of tobaccos in tropical countries and methods of reducing or preventing discoloration of packings under similar conditions. The lecturer stressed, in conclusion, the fact that there was still plenty of scope for further research, particularly with regard to the growing and manufacture of flue-cured cigarette tobaccos, the consumption of which in this country had increased enormously since the war and was threatening to oust the darker pipe tobaccos in the near future. Closer co-operation between grower and manufacturer as well as agricultural and manufacturing chemist, he remarked, would contribute much to this advance of scientific knowledge.

Chemical Engineering Group

Joint Meeting with S.C.I. at Bristol.

A JOINT meeting of the Chemical Engineering Group and the Bristol Section of the Society of Chemical Industry, will be held on Thursday, December 5, when the lithographic printing works of E. S. and A. Robinson, Ltd., will be visited. At the evening meeting in the chemical department of the University a joint paper on "Grass Silage and Silos" will be read by Mr. A. W. Ling, M.Sc., and Mr. W. R. Peel.

Continental Chemical Notes

Norway

THE REPORT OF THE NORSKE HYDRO for the year ending June, 1935, announces an appreciable improvement in trade. Whereas the previous year ended with a loss of about eight million kronen, the year under review ended with a profit of six million kronen, after 6.6 million kronen had been written off. A dividend of 2.2 per cent. upon the ordinary share capital is to be distributed. The company's new fertiliser factory at Heroya is expected to be completed next spring.

Italy

GLYCERINE-LITHARGE CEMENTS used in the electrical industries for such purposes as adhesion of porcelain insulators to metal supports have been found to absorb a considerable proportion of carbon dioxide. After three years, reports G. Gallo ("Ann. Chim. Applicata," 1935, p. 122), 42 per cent. of a cement had been transformed into basic lead carbonate. Since the respective volumes of litharge and basic lead carbonate are in the ratio of 1 to 5.5, it is easily understood why breakages of porcelain insulators are frequently reported. This risk can be obviated by simply coating the surface of the cement with an impermeable varnish.

France

THE SOC. FRANCAISE DU CAOUTCHOUC B has gone into liquidation, owing to the failure of its preliminary work on synthetic rubber manufacture after three-quarters of the capital had been spent.

A PATENTED PROCESS FOR MANUFACTURING POLYOXYMETHYLENE involves treatment of a formaldehyde solution with organic substances with an alkaline reaction (amines, ethanolamines, urea, etc.), preferably in the absence of methanol (French Pat. 765,540).

NEW COMPANY REGISTRATIONS INCLUDE: Laboratoires Anne de Laune, Paris, with a capital of 25,000 francs (cosmetics, perfumes and soaps); Lasgorceix et Cie, Paris, with a capital of 20,000 francs (production of bitumen building materials with the brand name of "Horn").

EXAMINATION OF THE PROPERTIES of highly purified (99.3 per cent.) calcium has revealed the relative stability of the pure metal in contact with hydrochloric acid diluted with alcohol. Caustic soda (26° Bé) has also been found to attack the pure metal very slowly although the action becomes more marked with increasing dilution (P. Bastien, "Rev. Métallurgie," 1935, p. 120).

Russia

AN EXPERIMENTAL PLANT FOR MAKING ETHYL ALCOHOL from the waste products of synthetic rubber manufacture is being installed at the S.K.-A. Synthetic Rubber Factory.

THE POSSIBILITY OF ELECTRODEPOSITING TANTALUM from aqueous solutions of its salts containing glucose, potassium salicylate or resorcinol is discussed by Izgarycher and Prede ("J. Obchtch Khim.," 1935, p. 1,422). Resorcinol gives the most promising results, but the increase in viscosity of the solution in course of electrolysis limits its value.

Jugoslavia

ENCOURAGING RESULTS HAVE FOLLOWED oil-drilling operations in the Bujabica district by the "Uljanik" Company. The oil is understood to comprise 15 per cent. benzine, 20 per cent. heavy oil and 65 per cent. high-grade machine oil.

A CONCESSION FOR MANUFACTURE OF ALUMINIUM from native bauxite has been granted for 15 years to the Aluminium Manufacturing Co., of Belgrade. It is stipulated that the factory be erected within three years, all the equipment for aluminium alloys completed within four years, and that the minimum annual production should reach 1,000 tons of aluminium and aluminium alloys.

Czecho-Slovakia

IT IS UNDERSTOOD THAT the New York firm, Warner Inc., is interested in the formation of a new pharmaceutical chemical company with a share capital of 500,000 kronen, which will take over the premises of the Eta Gramophone Factory in Prague.

ACCORDING TO A REPORT quoted in "Die Chemische Industrie," the transparent wrapping paper ("Primophan") factory at Nachod, belonging to J. Emmer and Sons, is to be closed down.

THE Canadian chemical industry is now taking rapidly increasing supplies of salt, the quantity utilised for chemical manufacture rising from 96,242 tons in 1932 to 124,132 tons in 1934. Nine firms were engaged in the industry last year, these having a total capital investment of $3,711,598 and employees numbering 469 persons, whose earnings aggregate $551,998. The total value of products was $2,558,322, the principal manufacture being table, dairy and pressed blocks of salt, valued at $1,098,817, the tonnage sold being 69,779. Common, fine, salt sold totalled 67,777 tons; common, coarse, totalled 20,488; brine for chemical works (salt equivalent) 124,132 tons.

Howards' Sports Association

Seventy-Fifth Annual Dinner

THE 75th annual dinner of the sports association of Howards and Sons, Ltd., was held in the new Jubilee Hall of the works canteen on November 23. Mr. Geoffrey Howard presided, supported by Mr. Bernard F. Howard, F.I.C., Lieut.-Col. Hugh Lloyd Howard and Mr. James D. Howard, with about 120 employees and friends. The chairman, replying to the toast of the firm, spoke of its proud position as manufacturers of fine chemicals, with a world-wide reputation of over 138 years—a reputation built up upon the quality of their products together with integrity in their business methods. The fine chemical industry to-day had attained a highly important position in international affairs, and had a very considerable bearing upon practically every interest with which world trade was concerned.

Mr. Bernard F. Howard and Lieut.-Col. Hugh Lloyd Howard, replying to further toasts, referred to the activities of the firm's social and athletic organisations, and mention was made of the splendid new Jubilee Hall built to commemorate the Royal Silver Jubilee.

Among the guests was Mr. C. Hireson, who held what must surely be a world's record. He had attended every annual dinner since the inception 75 years ago—a truly wonderful performance. Mr. Hireson had been an employee of the firm for over 58 years, and had retired upon pension in 1924, but was still in rigorous health, and hoped to attend many more of the firm's annual dinners.

Prizes were presented to members of the cricket team and winners of the various events held at the annual sports meeting, and to the prize winners of the miniature rifle club competitions.

British Chemical Industry

Professor Morgan Speaks of its Development

RECENT progress of British chemical industry was the theme of six lectures delivered by Professor G. T. Morgan, D.Sc., F.R.S., director of the Chemical Research Laboratory, Teddington, at the University College of Wales, Aberystwyth, November 19 to 26.

Following an introductory discourse concerning commercial acids and alkalis, Professor Morgan dealt with industrial gases, synthetic ammonia and its applications, synthetic hydrogen chloride, liquid chlorine and bleaching powder. Of the other manufacturers based on inorganic chemistry he described glass, phosphorus and its industrially important developments, and the production of barium and titanium compounds useful in the paint trade. A selection was made of metallurgical operations, including the preparation of aluminium, the production of pure nickel by the Mond carbonyl process, and the extraction of the precious metals of the platinum group. In fine chemicals and pharmaceutical products reference was made to synthetic dyes, drugs, hormones and vitamins, and the rapidly expanding trade in plastic materials.

Through the timely help of Mr. J. Davidson Pratt, of the Association of British Chemical Manufacturers, it became possible to illustrate these lectures by chemical products from the recent International Exhibition in Brussels.

THE OFFICERS AND COUNCIL of the Mineralogical Society for 1936 are as follows:—President, Sir Thomas H. Holland; vice-presidents, Sir William H. Bragg, Professor P. G. H. Boswell; treasurer, Mr. F. N. Ashcroft; general secretary, Lieut.-Col. W. C. Smith; foreign secretary, Professor A. Hutchinson; editor of the Journal, Dr. L. J. Spencer; ordinary members of council, Mr. T. Crook, Dr. W. F. P. McLintock, Mr. L. R. Wager, Dr. A. K. Wells, Professor A. Brammall, Mr. C. W. Mathews, Dr. T. C. Phemister, Mr. A. Broughton Edge, Professor H. H. Read, Mr. Arthur Russell, Mr. R. C. Spiller and Dr. Gilbert Wilson.

Pollution of the River Tees

Effects of Industrial Effluents

IN a report just issued by the Department of Scientific and Industrial Research as Water Pollution Research Technical Paper No. 5 (H.M. Stationery Office, 9s.), a detailed description is given of the results of a chemical and biological investigation of the estuary of the River Tees. This investigation, which occupied a period of about four years, formed part of a comprehensive survey of the whole of the river and its tributaries from its source on Cross Fell in the Pennines down to the sea.

Of the industrial effluents discharged into the Tees, the most important are those from by-product coke works. The main toxic constituents of these effluents are cyanide and tar acids. Approximately two tons of tar acids and nearly one ton of cyanide are contained in the average quantity of industrial effluent discharged each day. No other toxic substance enters the estuary in large quantities. Cyanide is much more toxic than tar acids, concentrations of 1 to 2 parts in 10 million parts of water being sufficient to kill fish in one hour. Systematic observations and experiments during periods when salmon and sea trout smolts were migrating through the estuary to the sea proved that cyanide, discharged as a constituent of effluents from coke ovens, has been the main cause of the death of large numbers of fish in the River Tees in recent years.

Several methods of treatment of the effluents containing cyanide were examined. In experiments on a large scale by one method, 5,000 gal. of effluent per hour were treated with lime and with waste liquid from local galvanising works. The untreated effluent in 1 per cent. dilution killed fish in a few minutes whereas the treated effluent in the same dilution was innocuous over a period of 24 hours. As a result of the work relating to effluents from coke ovens, it has been concluded that the discharges of such effluents into the Tees could be greatly reduced in quantity, and possibly avoided, by modifications in the methods employed for cooling and washing coke-oven gas and by the utilisation of the waste liquids for quenching coke. It is understood that as a result of the investigation installations of coke ovens to be erected in the future in the Tees area will be so designed that appreciable quantities of polluting liquids need not be discharged. With regard to pollution of the estuary by sewage, this could be reduced by treatment of the sewage in efficient purification works or by discharging the sewage into the sea at a point some distance from the shore.

Far Eastern Chemical Notes

Japan

ALUMINIUM IS NOW BEING MADE by the Korean Nitrogen Co.

A PLANT FOR PRODUCING POTASSIUM BICHROMATE is to be constructed at Tokyo by the Japanese Electro Industry Co.

HYDROGENATED OILS, in a monthly output of 350 tons, are to be produced in a factory at Tosa belonging to the Nankei Sarashiko K.K.

CARBON BISULPHIDE MANUFACTURE has commenced in a monthly output of 80 tons at the Tsurumi works of the Niigata Ryusan K.K.

BENZYL CELLULOSE is reported ("Chemische Industrie," November 9) to be the principal product of the Osaka factory of Showa Enso Kogyo K.K., the monthly output being 35 tons. Little demand, however, exists in Japan for this product at the present time.

NEW STARCH PRODUCTS FROM MILLET will be manufactured by the newly formed Toyo Kokusan K.K. (capital 1,000,000 yen) at factories in Osaka, Dairen and Mukden. Both technical and edible varieties of starch are in the company's programme of manufacture.

Inventions in the Chemical Industry

Patent Specifications and Applications

THE following information is prepared from the Official Patents Journal. Printed copies of Specifications accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Specifications open to Public Inspection

DELUSTRING LUSTROUS FIBROUS MATERIALS, process.—Böhme Fettchemie-Ges. May 15, 1934. 12067/35.

SYNTHETICALLY PREPARING OXYCAMPHOR, process.—Zaidan Hojin Rikagaku Kenkyujo. May 17, 1934. 12731/35.

PURIFICATION OF LIME ALUMINATES, processes.—J. C. Seailles. May 12, 1934. 13272/35.

CHEMICAL TREATMENT *of liquid* products.—Sharples Specialty Co. May 16, 1934. 13553/35.

HYDROGENATED FATTY ACIDS, process for production.—Mettallges A.-G. May 16, 1934. 13573/35.

PREPARING VALUABLE PRODUCTS, process.—Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. May 14, 1934. 13725/35.

FERRIFEROUS ORES, treatment.—K. Koller and Z. Gálòcsy. May 12, 1934. 13909/35.

SPONGE RUBBER from aqueous rubber dispersions, process for production.—Metallges A.-G. May 17, 1934. 14062/35.

VISCOSITY OF TARS, process for increasing.—C. A. Agthe. May 16, 1934. 14135/35.

TETRAHYDRO-3-OXYQUINOLINE DERIVATIVES, manufacture.—I. G. Farbenindustrie. May 16, 1934. 14369/35.

VANILLIN, process for preparation.—Je Mac A.-G. May 17, 1934. 14471/35.

DYEING AND DRESSING SKEINS, particularly applicable to cakes of artificial silk, process.—S. S. Daroca. May 18, 1934. 14692/35.

CARBON BLACK.—Krebo Pigment and Colour Corporation. May 18, 1934. 14746/35.

INSECTICIDES.—E. Hope. March 15, 1934. 31813/35.

Specifications Accepted with Date of Application

MONOAZO DYESTUFFS, manufacture.—Imperial Chemical Industries, Ltd., and A. H. Knight. May 3, 1934. 437,745.

PHOSPHORIC ACID-CONTAINING FERTILISERS, manufacture.—Aktiebolaget Kemiskapatenter. June 29, 1933. 437,833.

RESINS and plastic compositions containing them, manufacture. British Celanese, Ltd. July 12, 1933. 438,069.

SPECIFIC GRAVITY OF GASES, device for testing.—C. Gray. July 17, 1934. 437,979.

CELLULOSE ESTERS, treatment.—Distillers Co., Ltd., H. A. Auden and H. P. Staudinger. July 30, 1934. 437,907.

SEPARATION OF ASPHALT from heavy oils or residues.—Naamlooze Vennootschap Machinerieen-en Apparaten Fabrieken Meaf. Aug. 31, 1933. 437,843.

HYDROGENATING GASES of distillable carbonaceous materials, treatment.—International Hydrogenation Patents Co., Ltd. Nov. 24, 1933. 438,084.

PROCESS FOR MAKING COMPOUNDS of sulphhydryl keratinic acid and similar reduced degradation products of keratin with organic compounds containing arsenic.—R. Von Wülfing and E. Möller (trading as J. A. Wülfing (firm of)), E. Sturm and F. Fleischmann. Nov. 27, 1934. 437,769.

VINYL COMPOUNDS, polymerisation.—Carbide and Carbon Chemicals Corporation. Jan. 9, 1934. 437,773.

REFINED HYDROCARBONS and hydrocarbon mixtures, process of manufacturing.—H. D. Elkington (Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij). Feb. 22, 1935. 437,864.

GLYCOL ESTER DERIVATIVES.—Carbide and Carbon Chemicals Corporation. April 11, 1934. 437,790.

GLUTAMINE, manufacture and production.—I. G. Farbenindustrie. April 14, 1934. 437,873.

CONDENSATION PRODUCTS of the naphthalene series, manufacture. Durand and Huguenin A.-G. May 5, 1934. 437,798.

COMPRESSED CARBIDE BODIES, process for manufacture.—F. G. Brettell (Wiede's Carbidwerk Freyung). May 22, 1935. 438,008.

HYDROCARBON COMPOSITIONS.—Standard Oil Development Co. June 6, 1933. 437,934.

COPPER-THORIUM ALLOYS.—W. Guertler. April 28, 1933. 437,805.

FISH-LIVER OILS, particularly halibut-liver oil, production.—J. F. Ward. Feb. 9, 1934. 438,349.

PIGMENT PREPARATIONS, manufacture and application.—Imperial Chemical Industries, Ltd., M. Jones, W. F. Smith and A. Stewart. March 8, 1934. 438,192.

DESULPHURISATION OF CRUDE BENZINE, petroleum oils, shale oils, and other hydrocarbon oils containing sulphur, method.—N. D. Zelinsky and I. N. Titz. April 12, 1934. 438,354.

DISTILLING OR CONCENTRATING LIQUIDS, apparatus.—E. M. F. L. Guignard. April 17, 1934 438,423.

ARTIFICIAL TEXTILE MATERIALS, production.—British Celanese, Ltd., R. W. Moncrieff, and C. W. North. May 2, 1934. 438,119.

QUATERNARY AMMONIUM COMPOUNDS *of derivatives* of the anthracene series, manufacture and production.—Coutts and Co. and F. Johnson (legal representatives of J. Y. Johnson, deceased). (I. G. Farbenindustrie.) May 4, 1934. 438,122.

BIS-BETA DICHLOROALKYL ETHERS, process for making.—Carbide and Carbon Chemicals Corporation. May 11, 1933. 438,271.

RECOVERY OF PHENOLS from aqueous solutions, apparatus.—Coutts and Co. and F. Johnson (legal representatives of J. Y. Johnson deceased) (I. G. Farbenindustrie). May 7, 1934. 438,124.

KRYPTON AND XENON, process for obtaining.—Ges für Lindes Eismachinen A.-G. May 13, 1933. (Addition to 413,518.) 438,196.

THERAPEUTIC COMPOUNDS and processes of producing them.—E. Lilly and Co. May 27, 1933. 438,126.

IMPARTING OF BLOOM or green fluorescence in lubricating oils. Anglo-Iranian Oil Co., Ltd., and S. F. Birch. May 9, 1934. 438,425.

ARTIFICIAL FIBRES, manufacture.—W. W. Groves (I. G. Farbenindustrie). May 9, 1934. 438,199.

MONOAZO DYESTUFFS, manufacture.—I. G. Farbenindustrie. May 9, 1934. 438,129.

Applications for Patents

(November 7 to 13 inclusive.)

SUBSTANCES CONTAINING TANTALUM *or niobium*, treatment.—J. O. Farrer (Soc. Générale Métallurgique de Hoboken). 31276.

PLANTS for the chemical treatment of materials by liquid reagents.—Filtrators, Ltd., V. V. Saks, and L. W. Stubbs. 31192.

DIAZOAMINO COMPOUNDS, manufacture.—W. W. Groves (I. G. Farbenindustrie). 30847.

ADDITION COMPOUNDS containing sulphur, manufacture.—W. W. Groves (I. G. Farbenindustrie). 30933.

PROCESS of imparting hydrophobe properties to cellulose fibres. W. W. Groves (I. G. Farbenindustrie). 30934.

DYESTUFFFS OF THE ANTHRAQUINONE SERIES, manufacture.—W. W. Groves (I. G. Farbenindustrie). 31066.

DERIVATIVES OF PARAFFIN WAX, etc., manufacture.—D. W. F. Hardie, Imperial Chemical Industries, Ltd., and C. Cckrent. 31326, 31328.

MAGNESIUM, production.—I. G. Farbenindustrie. (Germany, Feb. 12.) 30958.

ZIRCONIUM COMPOUNDS, manufacture.—I. G. Farbenindustrie. (Germany, Nov. 8, '34.) 30967.

DYED ARTIFICIAL MASSES, manufacture.—I. G. Farbenindustrie. (Germany, Nov. 9, '34.) 30968.

ALKYLENE SULPHIDES, manufacture.—I. G. Farbenindustrie. (Germany, Nov. 10, '34.) 31154.

IRON FERROCYANIDE PIGMENTS.—Imperial Chemical Industries, Ltd., and C. Cckrent. (United States, Nov. 7, '34.) 30841.

DERIVATIVES OF XYLENE, manufacture.—Imperial Chemical Industries, Ltd., and C. Ockrent. 31,327.

MIXED POLYMERISATION PRODUCTS, production.—G. W. Johnson (I. G. Farbenindustrie). 30927.

POLYMERISATION PRODUCTS, manufacture.—G. W. Johnson (I. G. Farbenindustrie). 31142.

TREATING CARBONACEOUS MATERIAL.—J. S. Morgan. 31209.

DERIVATIVES OF THE LOWER OLEFINES, production.—J. S. Morgan. 31210.

HALOGENATED ORGANIC ACIDS, production.—Naamlooze Vennootschap de Bataafsche ePtroleum Maatschappij. (United States, Nov. 19, '34.) 30972.

ESTERS, manufacture.—E. Neumann. 30938.

PHOSPHORUSOXY CHLORIDE, manufacture.—E. Neumann, 31067.

CROTONALDEHYDE, process for making.—E. Neumann. 31068.

ZINC SULPHIDE.—New Jersey Zinc Co. (United States, Jan. 24.) 31472.

GASIFICATION OF MINERAL OILS, process.—C. Padovani. (Italy, Nov. 8, '34.) 30895.

PROCESS FOR FRACTIONALLY CONDENSING HYDROGEN PEROXIDE VAPOURS from mixtures with water vapour.—J. D. Riedel E. de Haën A.-G., and J. Seemann, 31057.

ALKYLARYLOXY ALKYLOLS, production.—Rohm and Haas Co. (United States, Nov. 30, '34.) 30897.

ACETYLENE, production.—Ruhrchemie, A.-G. (Germany, Aug. 19.) 30919.

PROTECTION OF CAST IRON, etc., against oxidation, process.—Soc. des Hauts-Fourneaux de la Chiers. (France, Nov. 21, '34.) 31063.

PLASTIC MATERIALS derived from mercaptans, manufacture.—Thiokol Corporation. (United States, April 23.) 31293.

PLASTIC MATERIALS derived from olefine disulphides, manufacture.—Thiokol Corporation. (United States, June 27.) 31294.

Weekly Prices of British Chemical Products

Review of Current Market Conditions

THERE has been a general rise of 2d. per lb. in the prices of mercurials. In the coal tar products section cresylic acid has been advanced, and there have been changes in the prices of a number of essential oils. Unless otherwise stated the prices below cover fair quantities net and naked at sellers' works.

LONDON.—The market continues to receive an increasing volume of inquiry and trading conditions have been fairly satisfactory. Prices continue on the whole steady and there is no change to report with the exception of the price for permanganate of potash, which has been reduced by 1d. per lb. In the coal tar products market pitch is quoted at about 37s. 6d. to 40s. per ton, f.o.b. East Coast port, for this season's delivery.

MANCHESTER.—Relatively bright trading conditions have been in evidence during the past week in most sections of the Manchester chemical market. There are still one or two easy spots, but in other directions values are well held and changes are more likely to be upward than downward. Interest in contract commitments for delivery over varying periods of next year is growing and few users who have so far entered the market are hesitating to book well ahead. There has been a fair sprinkling of orders placed this week for spot and near deliveries, and users are taking good quantities still of the leading materials. The market for tar products maintains its strong position, although there have been few important changes on balance for the week, and in a number of directions trading has been on an active scale.

SCOTLAND. — Business in chemicals for home trade has been rather quieter during the week, and there has also been a falling off in the demand for export. Prices, however, continue very steady at about previous figures with only slight changes to report. Prices for a number of chemicals for delivery during 1936 have now been announced, the rates generally being unchanged from current figures.

Price Changes

Coal Tar Products.—ACID, CRESYLIC, 99/100%, 2s. to 2s. 7d. per gal., according to specification; pale, 98%, 1s. 9d. to 1s. 10d.; dark, 1s. 5d. to 1s. 6d.

Pharmaceutical and Photographic Chemicals.—ACID, CITRIC, 1s. per lb.; MENTHOL, synthetic detached crystals, 7s. 9d. to 10s.; MERCURIALS, B.P., red oxide crystals, 6s. to 6s. 1d.; Levig. corrosive, 5s. 6d. to 5s. 7d.; sublimate—lump, 4s. 2d. to 4s. 3d., powder, 3s. 10d. to 3s. 11d.; white precipitate—lump, 4s. 11d. to 5s.; powder, 5s. 1d. to 5s. 2d.; calomel, 4s. 11d. to 5s.; yellow oxide, 5s. 4d. to 5s. 5d.; persulph., B.P.C., 5s. 1d. to 5s. 2d.; sulph. nig., 5s. to 5s. 1d.; PARALDEHYDE, 1s. 1½d.

Essential Oils.—ANISE, 2s. 2d. per lb.; BERGAMOT, 10s.; CANANGA, Java, 14s.; LEMON, 9s. 6d.; LEMONGRASS, 2s. 9d.; PEPPERMINT, Japanese, 6s. 3d.; PETITGRAIN, 5s. 3d.

All other prices remain unchanged.

General Chemicals

ACETONE.—LONDON: £62 to £65 per ton; SCOTLAND: £66 to £68 ex wharf, according to quantity.

ACID, ACETIC.—Tech. 80%, £38 5s. to £40 5s.; pure 80%, £39 5s.; tech., 40%, £20 5s. to £21 15s.; tech., 60%, £28 10s. to £30 10s. LONDON: Tech., 80%, £35 5s. to £37 5s.; pure 80%, £39 5s. to £41 5s.; tech., 40%, £20 5s. to £22 5s.; tech., 60%, £29 5s. to £31 5s. SCOTLAND: Glacial 98/100%, £48 to £52; pure 80%, £39 5s.; tech., 80%, £38 5s., d/d buyers' premises Great Britain. MANCHESTER: 80%, commercial, £39; tech. glacial, £52.

ACID, BORIC.—Commercial granulated, £25 10s. per ton; crystal, £26 10s.; powdered, £27 10s.; extra finely powdered, £29 10s. packed in 1-cwt. bags, carriage paid home to buyers' premises within the United Kingdom in 1-ton lots. SCOTLAND: Crystals, £26 10s.; powder, £27 10s.

ACID, CHROMIC.—10½d. per lb., less 2½%, d/d U.K.

ACID, CITRIC.—11¾d. per lb. MANCHESTER: 1s. SCOTLAND: 11¾d.

ACID, CRESYLIC.—97/100%, 1s. 5d. to 1s. 6d. per gal.; 99/100%, refined, 1s. 9d. to 1s. 10d. per gal. LONDON: 98/100%, 1s. 5d. f.o.r.; dark, 1s.

ACID, FORMIC.—LONDON: £40 to £45 per ton.

ACID, HYDROCHLORIC.—Spot, 4s. to 6s. carboy d/d according to purity, strength and locality. SCOTLAND: Arsenical quality, 4s.; dearsenicated, 5s. ex works, full wagon loads.

ACID, LACTIC.—LANCASHIRE: Dark tech., 50% by vol., £24 10s. per ton; 50% by weight, £28 10s.; 80% by weight, £48; pale tech., 50% by vol., £28; 50% by weight, £33; 80% by weight, £53; edible, 50% by vol., £41. One-ton lots ex works, barrels free.

ACID, NITRIC.—80° Tw. spot, £18 to £25 per ton makers' works. SCOTLAND: 80°, £24 ex station full truck loads.

ACID, OXALIC.—LONDON: £47 17s. 6d. to £57 10s. per ton, according to packages and position. SCOTLAND: 98/100%, £48 to £50 ex store. MANCHESTER: £49 to £54 ex store.

ACID, SULPHURIC.—SCOTLAND: 144° quality, £3 12s. 6d.; 168°, £7: dearsenicated, 20s. per ton extra.

ACID, TARTARIC.—1s. per lb. less 5%, carriage paid for lots of 5 cwt. and upwards. LONDON: 11½d., less 5%. SCOTLAND: 1s. 0¼d. less 5%. MANCHESTER: 1s. to 1s. 0¼d. per lb.

ALUM.—SCOTLAND: Lump potash. £8 10s. per ton ex store

ALUMINA SULPHATE.—LONDON: £7 10s. to £8 per ton. SCOTLAND: £7 to £8 ex store.

AMMONIA, ANHYDROUS.—Spot, 10d. per lb. d/d in cylinders. SCOTLAND: 10d. to 1s. containers extra and returnable.

AMMONIA, LIQUID.—SCOTLAND: 80°, 2½d. to 3d. per lb., d/d.

AMMONIUM BICHROMATE.—8d. per lb. d/d U.K.

AMMONIUM CARBONATE.—SCOTLAND: Lump, £30 per ton; powdered, £33, in 5-cwt. casks d/d buyers' premises U.K.

AMMONIUM CHLORIDE.—LONDON: Fine white crystals, £18 to £19. (See also Salammoniac.)

AMMONIUM CHLORIDE (MURIATE).—SCOTLAND: British dog tooth crystals, £32 to £35 per ton carriage paid according to quantity. (See also Salammoniac.)

ANTIMONY OXIDE.—SCOTLAND: Spot, £34 per ton, c.i.f. U.K ports.

ANTIMONY SULPHIDE.—Golden, 6½d. to 1s. 1d. per lb.; crimson, 1s. 5½d. to 1s. 7d. per lb., according to quality.

ARSENIC.—LONDON: £15 per ton c.i.f. main U.K. ports for imported material; Cornish nominal, £22 10s. f.o.r. mines. SCOTLAND: White powdered, £23 ex wharf. MANCHESTER: White powdered Cornish, £22, ex store.

ARSENIC SULPHIDE.—Yellow, 1s. 5d. to 1s. 7d. per lb.

BARIUM CHLORIDE.—LONDON: £10 10s. per ton. SCOTLAND: £10 10s. to £10 15s.

BARYTES.—£6 10s. to £8 per ton.

BISULPHITE OF LIME.—£6 10s. per ton f.o.r. London.

BLEACHING POWDER.—Spot, 35/37%, £7 19s. per ton d/d station in casks, special terms for contract. SCOTLAND: £9 5s.

BORAX, COMMERCIAL.—Granulated, £14 10s. per ton; crystal, £15 10s.; powdered, £16; finely powdered, £17; packed in 1-cwt. bags, carriage paid home to buyer's premises within the United Kingdom in 1-ton lots.

CADMIUM SULPHIDE.—4s. 10d. to 5s. 1d. per lb.

CALCIUM CHLORIDE.—Solid 70/75% spot, £5 5s. per ton d/d station in drums.

CARBON BISULPHIDE.—£31 to £33 per ton, drums extra.

CARBON BLACK.—3¾d. to 4¼d. per lb. LONDON: 4½d. to 5d.

CARBON TETRACHLORIDE.—SCOTLAND: £41 to £43 per ton, drums extra.

CHROMIUM OXIDE.—10½d. per lb., according to quantity d/d U.K.; green, 1s. 2d. per lb.

CHROMETAN.—Crystals, 3½d. per lb.; liquor, £19 10s. per ton d/d.

COPPERAS (GREEN).—SCOTLAND: £3 15s. per ton, f.o.r. or ex works.

CREAM OF TARTAR.—£3 19s. per cwt. less 2½%. LONDON: £3 17s. per cwt. SCOTLAND: £3 16s. 6d. net.

DINITROTOLUENE.—66/68° C., 9d. per lb.

DIPHENYLGUANIDINE.—2s. 2d. per lb.

FORMALDEHYDE.—LONDON: £25 10s. per ton. SCOTLAND: 40%, £25 to £28 ex store.

IODINE.—Resublimed B.P., 6s. 3d. to 8s. 4d. per lb.

LAMPBLACK.—£45 to £48 per ton.

LEAD ACETATE.—LONDON: White, £36 10s. per ton; brown, £1 per ton less. SCOTLAND: White crystals, £34 to £35; brown, £1 per ton less. MANCHESTER: White, £36; brown, £34 10s.

LEAD NITRATE.—£32 10s. to £34 10s. per ton.

LEAD, RED.—SCOTLAND: £25 to £27 per ton less 2½%; d/d buyer's works.

LEAD, WHITE.—SCOTLAND: £39 per ton, carriage paid. LONDON: £42 10s.

LITHOPONE.—30%, £16 10s. to £17 per ton.

MAGNESITE.—SCOTLAND: Ground calcined, £9 per ton, ex store.

MAGNESIUM CHLORIDE.—SCOTLAND: £7 per ton.

MAGNESIUM SULPHATE.—Commercial, £5 per ton, ex wharf.

METHYLATED SPIRIT.—61 O.P. industrial, 1s. 5d. to 2s. per gal.; pyridinised industrial, 1s. 7d. to 2s. 2d.; mineralised, 2s. 6d. to 3s. Spirit 64 O.P. is 1d. more in all cases and the range of prices is according to quantities. SCOTLAND: Industrial 64 O.P., 1s. 9d. to 2s. 4d.

PHENOL.—6¾d. to 7¼d. per lb. to June 30, 1936.
POTASH, CAUSTIC.—LONDON: £42 per ton. MANCHESTER: £38 to £39.
POTASSIUM BICHROMATE.—Crystals and Granular, 5d. per lb. less 5%, d/d U.K. Ground, 5½d. LONDON: 5d. per lb. less 5%, with discounts for contracts. SCOTLAND: 5d. d/d U.K. or c.i.f. Irish Ports. MANCHESTER: 5d.
POTASSIUM CHLORATE.—LONDON: £37 to £40 per ton. SCOTLAND: 99¾/100%, powder, £37. MANCHESTER: £38.
POTASSIUM CHROMATE.—6½d. per lb. d/d U.K.
POTASSIUM IODIDE.—B.P., 5s. 2d. per lb.
POTASSIUM NITRATE.—SCOTLAND: Refined granulated, £29 per ton c.i.f. U.K. ports. Spot, £30 per ton ex store.
POTASSIUM PERMANGANATE.—LONDON: 8¾d. per lb. SCOTLAND: B.P. crystals, 10d. to 10½d. MANCHESTER: B.P., 1s.
POTASSIUM PRUSSIATE.—LONDON: Yellow, 8½d. to 8¾d. per lb. SCOTLAND: Yellow spot, 8½d. ex store. MANCHESTER: Yellow, 8½d.
SALAMMONIAC.—First lump spot, £41 17s. 6d. per ton d/d in barrels. SCOTLAND: Large crystals, in casks, £36.
SODA ASH.—58% spot, £5 12s. 6d. per ton f.o.r. in bags.
SODA, CAUSTIC.—Solid, 76/77° spot, £13 17s. 6d. per ton d/d station. SCOTLAND: Powdered 98/99%, £17 10s. in drums, £18 5s. in casks, Solid 76/77°, £14 12s. 6d. in drums; 70/73%, £14 12s. 6d., carriage paid buyer's station, minimum 4-ton lots; contracts 10s. per ton less. MANCHESTER: £13 5s. to £14 contracts.
SODA CRYSTALS.—Spot, £5 to £5 5s. per ton d/d station or ex depot in 2-cwt. bags.
SODIUM ACETATE.—LONDON: £21 10s. SCOTLAND: £20 15s.
SODIUM BICARBONATE.—Refined spot, £10 10s. per ton d/d station in bags. SCOTLAND: Refined recrystallised £10 15s. ex quay or station. MANCHESTER: £10 10s.
SODIUM BICHROMATE.—Crystals cake and powder 4d. per lb. net d/d U.K. discount 5%. Anhydrous, 5d. per lb. LONDON: 4d. per lb. less 5% for spot lots and 4d. per lb. with discounts for contract quantities. MANCHESTER: 4d. per lb. basis. SCOTLAND: 4d. delivered buyer's premises with concession for contracts.
SODIUM BISULPHITE POWDER.—60/62%. £20 per ton d/d 1 cwt. iron drums for home trade.
SODIUM CARBONATE, MONOHYDRATE.—£15 per ton d/d in minimum ton lots in 2 cwt. free bags. Soda crystals, SCOTLAND: £5 to £5 5s. per ton ex quay or station. Powdered or pea quality, 7s. 6d. per ton extra. Light Soda Ash, £7 ex quay, min. 4-ton lots with reductions for contracts.
SODIUM CHLORATE.—£32 10s. per ton. SCOTLAND: 3¾d. per lb.
SODIUM CHROMATE.—4d. per lb. d/d U.K.
SODIUM HYPOSULPHITE.—SCOTLAND: Large crystals English manufacture, £9 5s. per ton ex stations, min. 4-ton lots. Pea crystals, £14 10s. ex station, 4-ton lots. MANCHESTER: Commercial, £10 5s.; photographic, £14 10s.
SODIUM META SILICATE.—£14 per ton, d/d U.K. in cwt. bags.
SODIUM IODIDE.—B.P., 6s. per lb.
SODIUM NITRITE.—LONDON: Spot, £18 5s. to £20 5s. per ton d/d station in drums.
SODIUM PERBORATE.—10%, 9¼d. per lb. d/d in 1-cwt. drums. LONDON: 10d. per lb.
SODIUM PHOSPHATE.—£13 per ton.
SODIUM PRUSSIATE.—LONDON: 5d. to 5½d. per lb. SCOTLAND: 5d. to 5¾d. ex store. MANCHESTER: 5d. to 5½d.
SODIUM SILICATE.—140° Tw. Spot, £8 per ton. SCOTLAND: £8 10s.
SODIUM SULPHATE (GLAUBER SALTS).—£4 2s. 6d. per ton d/d SCOTLAND: English material, £3 15s.
SODIUM SULPHATE (SALT CAKE).—Unground spot, £3 12s. 6d. per ton d/d station in bulk. SCOTLAND: Ground quality, £3 5s. per ton d/d. MANCHESTER: £3 5s.
SODIUM SULPHIDE.—Solid 60/62% Spot, £10 15s. per ton d/d in drums; crystals 30/32%, £8 per ton d/d in casks. SCOTLAND: For home consumption, Solid 60/62%, £10 5s.; broken 60/62%, £11 5s.; crystals, 30/32%, £8 7s. 6d., d/d buyer's works on contract, min. 4-ton lots. Spot solid, 5s. per ton extra. Crystals, 2s. 6d. per ton extra. MANCHESTER: Concentrated solid, 60/62%, £11; commercial, £8 2s. 6d.
SODIUM SULPHITE.—Pea crystals, spot, £13 10s. per ton d/d station in kegs. Commercial spot, £8 15s. d/d station in bags.
SULPHUR.—£9 10s. to £9 15s. per ton. SCOTLAND: £8 to £9.
SULPHATE OF COPPER.—MANCHESTER: £15 per ton f.o.b.
SULPHUR CHLORIDE.—5d. to 7d. per lb., according to quality.
SULPHUR PRECIP.—B.P., £55 to £60 per ton according to quantity. Commercial, £50 to £55.
VERMILION.—Pale or deep, 4s. 8d. per lb. in 1-cwt. lots.
ZINC CHLORIDE.—SCOTLAND: British material, 98%, £18 10s. per ton f.o.b. U.K. ports.
ZINC SULPHATE.—LONDON: £12 per ton. SCOTLAND: £10 10s.
ZINC SULPHIDE.—10d. to 11d. per lb.

Coal Tar Products

ACID, CRESYLIC.—90/100%, 2s. to 2s. 7d. per gal., according to specification; pale 98%, 1s. 9d. to 1s. 10d.; dark, 1s. 5d. to 1s. 6d. LONDON: 98/100%, 1s. 4d.; lark, 95/97%, 1s. SCOTLAND: Pale, 99/100%, 1s. 3d. to 1s. 4d.; dark, 97/99%, 1s. to 1s 1d.; high boiling acid, 2s. 6d. to 3s.
ACID, CARBOLIC.—Crystals, 6¾d. to 7¼d. per lb.; crude, 60's, 1s. 11½d. to 2s. 2½d. per gal. MANCHESTER: Crystals, 7¼d. per lb.; crude, 2s. 4d. per gal. SCOTLAND: 60's, 2s. 6d. to 2s. 7d.
BENZOL.—At works, crude, 9½d. to 10d. per gal.; standard motor 1s. 3d. to 1s. 3½d.; 90%, 1s. 4d. to 1s. 4½d.; pure, 1s. 7½d. to 1s. 8d. LONDON: Motor, 1s. 3½d. SCOTLAND: Motor, 1s. 6½d.
CREOSOTE.—B.S.I. Specification standard, 5¾d. per gal. f.o.r. Home, 3¾d. d/d. LONDON: 4½d. f.o.r. North; 5d. London. MANCHESTER: 5½d. SCOTLAND: Specification oils, 4d.; washed oil, 4½d. to 4¾d.; light, 4½d.; heavy, 4¼d. to 4½d.
NAPHTHA.—Solvent, 90/100%, 1s. 5½d. to 1s. 6½d. per gal.; 95/160%, 1s. 7d.; 99%, 11d. to 1s. 1d. LONDON: Solvent, 1s. 3½d. to 1s. 4d.; heavy, 11d. to 1s. 0½d. f.o.r. SCOTLAND: 90/160%, 1s. 3d. to 1s. 3½d.; 90/190%, 11d. to 1s. 2d.
NAPHTHALENE.—Crude, whizzed or hot pressed, £10 10s. per ton; purified crystals, £13 10s. per ton in 2-cwt. bags. LONDON: Fire lighter quality, £3 to £3 10s.; 74/76 quality, £4 to £4 10s.; 76/78 quality, £5 10s. to £6. SCOTLAND: 40s. to 50s.; whizzed, 70s. to 75s.
PYRIDINE.—90/140%, 5s. 6d. to 8s. per gal.; 90/180, 2s. 3d.
TOLUOL.—90%, 2s. 3d. to 2s. 4d. per gal.; pure, 2s. 6d. to 2s. 7d.
XYLOL.—Commercial, 2s. 3d. per gal.; pure, 2s. 4d.
PITCH.—Medium, soft, 35s. to 36s. per ton, in bulk at makers' works.

Wood Distillation Products

ACETATE OF LIME.—Brown, £8 to £9. Grey, £11. Liquor, brown, 30° Tw., 8d. per gal. MANCHESTER: Brown, £9 10s.; grey £11 10s.
CHARCOAL.—£4 15s. to £10 per ton, according to grade and locality.
METHYL ACETONE.—40-50%, £43 to £46 per ton.
WOOD CREOSOTE.—Unrefined, 3d. to 1s. 3d. per gal.
WOOD NAPHTHA, MISCIBLE.—2s. 6d. to 3s. 6d. per gal.; solvent, 3s. 3d. to 4s. 3d. per gal.
WOOD TAR.—£2 to £2 10s. per ton.

Nitrogen Fertilisers

SULPHATE OF AMMONIA.—The price for December delivery is £7 5s. per ton, less 4s. 6d., neutral quality basis 20.6% nitrogen in 6-ton lots delivered to farmer's nearest station.
year 1935/36 are: December £7, January £7 1s. 3d., February £7 2s. 6d., March £7 3s. 9d., April/June, £7 5s., delivered in 4-ton lots.
NITRO-CHALK.—The price for the 1935/36 season is £7 5s. per ton delivered in 6-ton lots to farmer's nearest station—all terms and conditions the same as for the season 1934/35.
NITRATE OF SODA.—The price for the 1935/36 season is £7 12s. 6d. per ton delivered in 6-ton lots to farmer's nearest station—all terms and conditions the same as for the season 1934/35.
CONCENTRATED COMPLETE FERTILISERS.—£10 10s. to £10 19s. per ton according to analysis, delivered in 6-ton lots to farmer's nearest station.
AMMONIUM PHOSPHATE (N.P.) FERTILISERS.—£10 5s. to £13 15s. per ton according to analysis, delivered in 6-ton lots to farmer's nearest station.

Latest Oil Prices

LONDON, Nov. 27.—LINSEED OIL was quiet. Spot, £27 5s. per ton (small quantities); Dec., £24 12s. 6d.; Jan., £24 17s. 6d.; Jan.-April, £25; May-Aug., £25 5s., naked. SOYA BEAN OIL was quiet. Oriental (bulk), Dec. shipment, £22 per ton. RAPE OIL was steady. Crude, extracted, £36 10s. per ton; technical refined, £38, naked, ex wharf. COTTON OIL was firm. Egyptian crude, £26 per ton; refined common edible, £30; and deodorised, £32, naked, ex mill (small lots, £1 10s. extra). TURPENTINE was dull. American, spot, 44s. 9d. per cwt.
HULL.—LINSEED OIL, spot, quoted £25 15s. per ton; Nov.-Dec., £25 2s. 6d.; Jan.-April, £25 5s.; May-Aug., £25 7s. 6d. COTTON OIL.—Egyptian, crude, spot, £26 10s. per ton; edible, refined, spot, £29 10s.; technical, spot, £29 10s.; deodorised, £31 10s., naked. PALM KERNEL OIL, crude, f.m.q., spot, £23 10s. per ton, naked. GROUNDNUT OIL, extracted, spot, £33 per ton; deodorised, £36. RAPE OIL, extracted, spot, £35 10s. per ton; refined, £37. SOYA OIL, extracted, spot, £27 10s. per ton; deodorised, £30 10s. COD OIL, f.o.r. or f.a.s, 25s. per cwt. in barrels. CASTOR OIL, pharmaceutical, 45s. per cwt.; first, 40s.; second, 38s. TURPENTINE, American, spot, 46s. 9d. per cwt.

AFTER the 12 per cent. increase in imports of chemicals and allied products into Egypt during the calendar year 1934, imports for the first half of 1935 fell back slightly; exports, however, declined in both periods. Imports of chemicals and allied products comprised of the usual commodities amounted to £3,481,100 in 1934, and £1,668,000 in the first six months of 1935. Of the total exports valued at £488,800 in 1934, and £221,200 in the first of 1935, phosphate rock accounted for the bulk of the total. Exports of phosphate rock declined from 483,200 tons (£416,600) in 1933 to 469,600 tons (£404,100) in 1934, and 216,100 tons (£188,900) in the first half of 1935. Beeswax, gum arabic and small amounts of other chemicals account for the remainder of the exports.

Chemical and Allied Stocks and Shares

Buoyant Market Conditions

ACTIVELY-dealt-in shares of chemical companies have reflected the general market tendency to rather lower prices, but numerous individual features of interest were again in evidence. Imperial Chemical have lost a few pence of their improvement of the previous week, but continued to show increased activity, the new blue pigment discovered by the chemists of the British Dyestuffs subsidiary and the news that African Explosives, another subsidiary, is investigating the possibility of manufacturing in South Africa the cyanide required by the Rand gold mining industry, having drawn attention to the wide ramifications of the I.C.I. group. There has been a continuance of increased activity in shares of companies interested in the manufacture of fertilisers and similar products. Fison, Packard and Prentice have more than held their recent advance. Lawes' Chemical ordinary were also reported to be in better demand, while Cooper, McDougall and Robertson retained their good improvement of the previous week. The rise in the last named is attributed in the market to the improved Argentine exchange conditions which are in prospect. Despite the fact that the company's dividend record compares favourably with that of many other companies which operate on a world basis, it has had to face exchange losses in South America, and the latest developments suggest these may be a good deal smaller in respect of the current year. Imperial Smelting were firmer under the influence of the interesting detailed review of the company's position given at the recent annual meeting. British Oil and Cake Mills continued a better market and United Premier Oil and Cake were also inclined to be in larger demand. It was mentioned last week that favourable dividend estimates are current in the market with regard to the latter. B. Laporte were dull on the absence of a larger interim dividend, but anticipations of an increased total dividend for the year persist. United Molasses continued in demand on the favourable anticipations attaching to the past year's results, and although all their recent improvement has not been held, Distillers were active, partly on the possibility that at the forthcoming meeting of United Molasses reference may be made to industrial alcohol prospects. Distillers has a shareholding in United Molasses and both are interested in the Solvent Products Co. Goodlass Wall remained firm, aided by the market belief that the lead section of the company's business will be assisted by the higher price of the metal. Triplex Safety Glass were in request on any reaction. In this case market anticipations are that, partly owing to the new departments of the business, including the making of scientific instruments, profits may advance further and a more liberal dividend may be forthcoming. It is possible the company may resume the practice of paying an interim dividend. Dealings have commenced in the 5½ per cent. "A" cumulative preference and 6 per cent. "B" cumulative preference shares of William Briggs and Sons, the old-established Scottish chemical company which specialises in the production of tar and bitumen for road construction and bitumen compounds for various trades. The recently issued particulars showed that profits for the twelve months to September 30 last were equivalent to more than six times the amount to meet the dividend on the "A" preference shares and to more than five times the amount required to pay the combined dividends on the "A" and "B" preference shares in which dealings have now commenced. A favourable impression was created by the resumption of interim dividends by Anglo-Iranian Oil with a payment of 5 per cent. It is assumed that the "Shell" and Royal Dutch companies would also have recommenced interim dividends had it not been for the uncertainty attaching to the French and Dutch among positions at the present time.

Name.	Nov. 26.	Nov. 19.
Anglo-Iranian Oil Co., Ltd. Ord.	70/-	68/1½
,, 8% Cum. Pref.	37/-	37/-
,, 9% Cum. Pref.	38/3	38/3
Associated Dyers and Cleaners, Ltd. Ord.	2/6	2/6
,, 6½% Cum. Pref.	5/3¾	5/3¾
Associated Portland Cement Manufacturers, Ltd. Ord.	67/-	67/6
,, 5½% Cum. Pref.	28/-	27/6
Benzol & By-Products, Ltd. 6% Cum. Part Pref.	2/6	2/6
Berger (Lewis) & Sons, Ltd. Ord.	65/-	65/-
Bleachers' Association, Ltd. Ord.	7/6	8/1½
,, 5½% Cum. Pref.	12/6	13/9
Boake, A., Roberts & Co., Ltd. 5% Pref. (Cum.)	20/-	20/-
Boots Pure Drug Co., Ltd. Ord. (5/-)	49/-	49/3
Borax Consolidated, Ltd. Pfd. Ord. (£)	100/-	100/-
,, Defd. Ord.	17/9	17/9
,, 5½% Cum. Pref. (£10)	£11/2/6	£11
,, 4½% Deb. (1st Mort.) Red. (£100)	£109	£109
,, 4½% 2nd Mort. Deb. Red. (£100)	£102	£102
Bradford Dyers' Association, Ltd. Ord.	10/7½	10/7½
,, 5% Cum. Pref.	13/1½	14/4½
,, 4% 1st Mort. Perp. Deb. (£100)	£88	£88
British Celanese, Ltd. 7% 1st Cum. Pfd.	25/9	25/9
,, 7½% Part 2nd Cum. Pref.	23/6	23/9
British Cotton & Wool Dyers' Association Ltd. Ord. (5/-)	6/3	6/3
,, 4% 1st Mort. Deb. Red. (£100)	£94	£94
British Cyanides Co., Ltd. Ord. (2/-)	3/3	3/3
British Drug Houses, Ltd. Ord.	18/9	18/9
,, 5% Cum. Pref.	21/3	21/3
British Glues and Chemicals, Ltd. Ord. (4/-)	7/3	6/9
,, 8% Pref. (Cum. and Part.)	28/1½	28/1½
British Oil and Cake Mills, Ltd. Cum. Pfd. Ord.	49/4½	48/1½
,, 5½% Cum. Pref.	26/3	26/3
,, 4½% First Mort. Deb. Red. (£100)	£106/10/-	£106/10/-
British Oxygen Co., Ltd. Ord.	113/9	113/10
,, 6½% Cum. Pref.	32/6	32/6
British Portland Cement Manufacturers, Ltd. Ord.	90/-	92/6
,, 6% Cum. Pref.	30/6	30/6
Bryant & May, Ltd. Pref.	66/3	66/3
Burt, Boulton & Haywood, Ltd. Ord.	20/-	20/-
,, 7% Cum. Pref.	27/6	27/6
,, 6% 1st Mort. Deb. Red. (£100)	£105/10/-	£105/10/-
Bush, W. J., & Co., Ltd. 5% Cum. Pref. (£5)	108/9	108/9
,, 4% 1st Mort. Deb. Red. (£100)	£96/10/-	£96/10/-

Name.	Nov. 26.	Nov. 19.
Calico Printers' Association, Ltd. Ord.	10/7½	10/7½
,, 5% Pref. (Cum.)	16/3	16/3
Cellulose Acetate Silk Co., Ltd. Ord.	14/-	14/-
,, Deferred (1/-)	2/4½	2/7½
Consett Iron Co., Ltd. Ord.	11/-	11/9
,, 8% Pref.	28/9	28/9
,, 6% First Deb. stock, Red. (£100)	£107/10/-	£107/10/-
Cooper, McDougal & Robertson, Ltd. Ord.	36/3	36/3
,, 7% Cum. Pref.	28/9	28/9
Courtaulds, Ltd. Ord.	55/7½	55/7½
,, 5% Cum.	26/3	26/3
Crosfield, Joseph, & Sons, Ltd. 5% Cum. Pre Pref.	25/-	25/-
,, Cum. 6% Pref.	28/9	28/9
,, 6½% Cum. Pref.	30/7½	27/10½
,, 7½% "A" Cum. Pref.	30/7½	30/7½
Distillers Co., Ltd. Ord.	96/-	96/-
,, 6% Pref. Stock Cum.	31/6	31/6
Dorman Long & Co., Ltd. Ord.	21/3	22/6
,, Pref. Ord.	28/9	30/-
,, 6½% Non-Cum. 1st Pref.	23/6	23/6
,, 8% Non-Cum. 2nd Pref.	21/3	m 23/-
,, 4% First Mort. Perp. Deb. (£100)	£102/10/-	£102/10/-
,, 5% 1st Mort. Red. Deb. (£100)	£107	£107
English Velvet & Cord Dyers' Association, Ltd. Ord.	5/-	4/4½
,, 5% Cum. Pref.	8/9	7/6
,, 4% First Mort. Deb. Red. (£100)	£73/10/-	£72/10/-
Fison, Packard & Prentice, Ltd. Ord.	43/9	41/10½
,, 7% Non-Cum. Pref.	31/3	31/3
,, 4½% Debs. (Reg.) Red. (£100)	£106	£106
Gas Light & Coke Co., Ord.	28/-	28/-
,, 3½% Maximum Stock (£100)	£89/10/-	£89/10/-
,, 4% Consolidated Pref. Stock (£100)	£106/10/-	£106/10/-
,, 3% Consolidated Deb. Stock, Irred. (£100)	£89/10/-	£88/10/-
,, 5% Deb. Stock Red. £100)	£116/10/-	£116/10/-
,, 4½% Red. Deb. Stock (1960-65) (£100)	£113/10/-	£113/10/-
Goodlass Wall & Lead Industries, Ltd. Ord. (10/-)	14/4½	14/4½
,, 7% Prefd. Ord. (10/-)	13/9	13/9
,, 7% Cum. Pref.	28/9	28/9
Gossage, William, & Sons, Ltd. 5% 1st Cum. Pref.	24/4½	24/4½
,, 6½% Cum. Pref.	28/9	28/9
Imperial Chemical Industries, Ltd. Ord.	37/3	37/6
,, Deferred (10/-)	9/11½	9/11½
,, 7% Cum. Pref.	33/6	33/6
Imperial Smelting Corporation, Ltd. Ord.	15/-	15/-
,, 6½% Pref. (Cum.)	24/3	24/3

Name.	Nov. 26.	Nov. 19.
International Nickel Co. of Canada, Ltd. Cum.	$39¼	$38¼
Johnson, Matthey & Co., Ltd. 5% Cum. Pref. (£5)	105/-	105/-
,, 4% Mort. Deb. Red. (£100)	£98/10/-	£98/10/-
Laporte, B., Ltd. Ord.	118/9	117/6
Lawes Chemical Co., Ltd. Ord. (1/-)	6/3	6/3
,, 7% Non-Cum. Part Pref. (10/-)	10/-	10/-
Lever Bros., Ltd. 7% Cum. Pref.	32/-	32/3
,, 8% Cum. "A" Pref.	33/-	33/-
,, 20% Cum. Prefd. Ord.	78/1½	77/6
,, 5% Cons. Deb. (£100)	£106	£106
,, 4% Cons. Deb. (£100)	£103	£103
Magadi Soda Co., Ltd. 12½% Pref. Ord. (5/-)	1/3	1/3
,, 6% 2nd Pref. (5/-)	6d.	6d.
,, 6% 1st Debs. (Reg.)	£40	£40
Major & Co., Ltd. Ord. (5/-)	7½d.	7½d.
,, 8% Part. Prefd. Ord. (10/-)	9d.	9d.
,, 7½% Cum. Pref.	1/6¾	1/6¾
Pinchin, Johnson & Co., Ltd. Ord. (10/-)	43/6	43/6
,, 1st Pref. 6½% Cum.	32/-	31/6
Potash Syndicate of Germany (Deutsches Kalisyndikat G.m.b.H.) 7% Gld. Ln. Sr. "A" and "B" Rd.	£70	£70

Name.	Nov. 26.	Nov. 19.
Reckitt & Sons, Ltd. Ord.	116/10½	115/7½
,, 4½% Cum. 1st Pref.	25/-	25/-
Salt Union, Ltd. Ord.	43/9	40/-
,, Pref.	45/-	46/3
,, 4½ Deb. (£100)	£109/10/-	£109/10/-
South Metropolitan Gas Co. Ord. (£100)	£135/10/-	£136/10/-
,, 6% Irred. Pref. (£100)	£149/10/-	£149/10/-
,, 4% Pref. (Irred.) (£100)	£107	£107
,, Perpetual 3% Deb. (£100)	£88/10/-	£87/10/-
,, 5% Red. Deb. 1950-60 (£100)	£116/10/-	£116/10/-
Staveley Coal and Iron Co., Ltd. Ord.	46/10½	48/1½
Stevenson & Howell, Ltd. 6½% Cum. Pref.	26/3	26/3
Triplex Safety Glass Co., Ltd. Ord. (10/-)	82/6	82/6
Unilever, Ltd. Ord.	31/3	31/10½
,, 7% Cum. Pref.	28/9	29/3
United Glass Bottle Manufacturers, Ltd. Ord.	44/-	43/6
,, 7½% Cum. Pref.	33/-	33/-
United Molasses Co., Ltd. Ord. (6/8)	21/3	21/3
,, 6% Cum. Pref.	25/-	25/-
United Premier Oil & Cake Co., Ltd. Ord. (5/-)	8/9	8/6
,, 7% Cum. Pref.	24/4½	24/4½
,, 6% Deb. Red. (£100)	£102/10/-	£102/10/-

From Week to Week

THE SHETTLESTON OIL AND CHEMICAL CO. (East of Glasgow) are to extend their works.

THE SCOTIA IRON AND CHEMICAL CO., which has taken over the Langloan Iron Works, Coatbridge, expects to begin operations early in 1936 for the manufacture of pig-iron and coal by-products.

THE OCTOBER ISSUE of the "Bulletin of the Imperial Institute" contains reports of recent investigations on African oil seeds, African beeswax, and a new gutta from South Africa. The scientific aspects of cacao fermentation is the subject of a further article by Mr. A. W. Knapp, chief chemist, Cadbury Bros., Ltd.

THE COUNCIL OF THE SENATE of Cambridge University reports that Dr. P. Kapitza no longer holds the Messel Research Professorship of the Royal Society, and in consequence he has ceased to be director of the Royal Society Mond Laboratory, at Cambridge. They recommend that Lord Rutherford, Cavendish Professor of Experimental Physics, who has been acting director since Dr. Kapitza left, shall continue to act as such until a new director is appointed.

COLVILLES, LTD., have officially announced an extension scheme at the Glengarnock steel works, Ayrshire, involving a total cost of £250,000. The work will take a year to complete, and will give an additional capacity of 2,500 tons per week, doubling the present capacity of this plant. Two new open hearth melting furnaces are planned, the present melting equipment comprising four furnaces. The plant is designed to add to the productive capacity in semi-finished steel which is in acute short supply in the West of Scotland as in other districts.

ADVANCES WHICH HAVE BEEN MADE in recent years towards a closer approach to the absolute zero of temperature (on the Kelvin scale) were discussed on November 20 in a lecture delivered by Professor E. Taylor Jones to the Royal Philosophical Society of Glasgow. Professor Jones said that until three years ago the lowest temperature reached had been obtained by evaporating liquid helium under reduced pressure. The new method made use of the cooling of a paramagnetic salt by rapid demagnetisation. Commenting on the latest research in electricity, he said that experiments on electron diffraction showed that an electron could be treated as a vibrator. The lecture was illustrated by lantern slides showing modern low-temperature apparatus and electron diffraction patterns.

THE BRITISH CYANIDES SOCIAL AND SPORTS CLUB has inaugurated a new house organ under the title of the "Beetle Magazine." The magazine, originally intended as a sports club bulletin, has become the pioneer effort at producing an official house organ of the Cyanides Group of companies, whose original trade mark is the beetle. Historical observations on the firm's career are included in the magazine, and the Editor, in sending us a review copy, points out that through the past years of general depression and from a point of almost complete stagnation about the year 1925, an entirely new industry has been created by the British Cyanides Co., finding employment for 250 people at Oldbury and 500 in the Streetly and Walsall district.

JAMES ROBINSON AND CO., LTD., archill, cudbear and aniline dye manufacturers, etc., Hillhouse Lane, Huddersfield, have increased their nominal capital by the addition of £11,000 in £1 shares beyond the registered capital of £10,000.

ACCORDING TO THE NOVEMBER ISSUE of the "Bulletin of the International Tin Research and Development Council," world apparent consumption of tin increased by over 18 per cent. to 104,443 tons in the first nine months of 1935, compared with 88,341 tons in the corresponding period of 1934.

THE DUKE OF KENT paid an informal visit to the National Physical Laboratory at Teddington on November 25, and was conducted round by Sir Frank Smith, secretary of the Department of Scientific and Industrial Research. He showed great interest in the investigations in the new acoustics laboratory, whose object is to discover and test materials and methods of construction to ensure the greatest degree of sound-proofness in working-class flats.

MEETINGS OF BOTH CLASSES of ordinary shareholders of Thos. Firth and John Brown, Ltd., on November 25, approved the increase of capital from £2,450,000 to £2,550,000 by the creation of an additional 100,000 £1 "A" ordinary shares. It was explained that the additional capital was required to meet expenditure on works extensions rendered both necessary and desirable by an increased volume of trade, and for the general purposes of the company. It was added that arrangements had been made for the subscription of the additional shares at a substantial premium.

THE WILLIAM DIXON SCHEME to produce coke oven gas as a by-product at the Govan Iron Works, Glasgow, known as Dixon's Blazes, is expected to start production early in the new year. The company has spent nearly £500,000 on the development of Polkemmet Colliery for the production of coking coal, and about £300,000 on the erection of the coke oven battery at the Govan Iron Works. The directors intend to approach the Glasgow Corporation to buy the by-product gas in large quantities, and believe that if an agreement can be secured, it will enable the company to produce iron on favourable terms in competition with English and Indian firms.

THE CHINA CLAY SHIPMENTS for October were remarkably good notwithstanding the adverse shipping weather and also that no despatches were made from either Looe, Padstow or Penzance. The striking features of the October trade was the increases in both china clay and china stone compared with either the previous month or in October, 1934. In October, 1934 the total tonnage dealt with was about 71,000 tons, and October, 1935, the aggregate turnover was 73,543. Another interesting point regarding the past month is that over 7,000 tons were despatched to inland towns by railway. Details of October shipping are as follows:—Fowey—43,952 tons china clay, 4,160 tons china stone, 3,744 tons ball clay. Par—8,580 tons china clay, 260 tons china stone. Charlestown—5,177 tons china clay, 519 tons china stone. Plymouth—146 tons china clay. Despatched by rail—7,005 tons china clay, making a total of 64,660 tons china clay, 4,939 tons china stone and 3,744 tons of ball clay.

Electrical Insulating Varnishes

British Standard Specification

It is not often realised that insulating varnishes are one of the most important of materials in electrical machinery, and are used either as insulators themselves or to reinforce the insulation provided by the various fabrics and tapes which are commonly used in the manufacture of electrical machinery. The cost of the varnish is an almost negligible proportion of the value of the machine, yet the successful working of the latter depends almost entirely on the efficiency of the insulation, and it is here that the varnish plays its part. For all the more arduous duties, and on heavy machinery baking oil varnish is used, and a British specification for this varnish was published in 1930. For lower priced machines which are not subjected to severe stresses, and in repair shops, however, air-drying insulating varnish has proved popular.

With a view to improving the properties of thism type of varnish, the British Electrical and Allied Industrial Research Association carried out extensive research and requested the British Standards Institution to set up a committee to prepare a specification for air drying insulating varnish based on the results of their research. The resulting specification (No. 634) recognises two types of air drying insulating varnish: (1) Varnish with methylated spirit solvent, and (2) varnish with non-alcoholic solvent. To comply with the specification varnish must satisfy specified tests for percentage volatile matter, specific gravity, viscosity, drying time, electric strength n damp atmosphere, ageing and flash point.

Chemical Trade Inquiries

The following trade inquiries are abstracted from the "Board of Trade Journal." Names and addresses may be obtained from the Department of Overseas Trade (Development and Intelligence), 35 Old Queen Street, London, S.W.1 (quote reference number).

Finland.—A firm of agents established at Helsingfors wishes to obtain the representation, on a commission basis, of United Kingdom manufacturers of metal cloth (for cellulose and paper industries); steel tubes (for furniture and bicycles); rustless steel; silver paper (for confectionery); aluminium bobbins (for textile industry); tinfoil (for tobacco industry). (Ref. No. 471.)

France.—An agent established at Neuilly-sur-Seine wishes to obtain the representation, on a commission basis, of United Kingdom manufacturers of building requisites, particularly good quality wall distempers and chemical products. (Ref. No. 472.)

Holland.—An agent established at Amsterdam wishes to obtain the representation, on a commission basis, of United Kingdom manufacturers of pharmaceutical chemicals. (Ref. No. 473.)

Egypt.—The Commercial Secretary to the Residency, Egypt, reports that the Department of Public Health is calling for tenders, to be presented in Cairo by February 8, 1936, for the supply of 118 metric tons of disinfectant fluid for general purposes and 14,550 kilos of disinfectant for medical purposes. (Ref. T.Y. 168); also for the supply of medicinal oils. (Ref. T.Y. 169.)

New Companies Registered

Aniska Preparations (Rand's), Ltd. (307,316), 230 Vauxhall Bridge Road, S.W.1.—Private company. Registered November 22. Nominal capital £100. Manufacturers of and dealers in chemicals, gases, drugs, medicines, plaster of paris, etc. Directors: A. L. Rand, P. G. Rand, F. V. Rand, J. Sim, M.P.S.

Colloid Products, Ltd., 14 Netherfield Street, Glasgow.—Registered November 15. Nominal capital £6,000. Manufacturers and refiners of, agents for and dealers in and testers and analysts of all classes of chemicals, gases, compounds, mixtures, emulsions, etc. Directors: G. T. MacLeod, John Muir, A. G. Templeton.

Siendro, Ltd. (307,032). 45 Bloomsbury Square, W.C.1.—Registered November 14. Nominal capital £1,000. Manufacturers of and dealers in chemicals, gases, drugs, medicines, plaster of paris, etc. A subscriber: Geo. J. Badcock.

Welch & Horner, Ltd., 9 and 10 Jewry Street, E.C.—Registered November 15. Nominal capital £1,000. Manufacturers, producers and distillers and importers of and dealers in drugs, essential oils, chemicals, medicines, etc. Directors: J. McKenzie, Mrs. E. L. McKenzie, S. G. M. Welch.

White Fuel Patents, Ltd., 20 Ash View Gardens, Ashford, Mdx.—Registered November 18. Nominal capital £1,000. Manufacturers, producers and importers of and dealers in patent fuel, coke and coal by-products, motor spirits, naphtha oils, dyes, benzene, etc. A subscriber: James E. Nash.

William Briggs & Sons, Ltd., East Camperdown Street, Dundee.—Registered November 14. Nominal capital £100. Objects: To acquire the business of William Briggs & Sons, Ltd., chemicals manufacturers, manufacturers of vitumen, refiners and distillers of oils and tar and road, shipping and other contractors, etc. Directors are: J. A. Briggs, A. S. Briggs, A. G. A. Goudie.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

WIMSOL, LTD., Keighley, chemical mfrs., etc. (M., 30/11/35.) Reg. Nov. 14, £256 further charge, to Keighley and Craven Building Soc.; charged on land and premises in Pitt Street, Keighley.

County Court Judgments

(Note.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for damages or otherwise, and the result of bona-fide contested actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors we do not report subsequent County Court Judgments against him.)

KUBY, SOLY, 27 Alexandra Road, Twickenham, retired research chemist. (C.C., 30/11/35.) £14 11s. 4d. Oct. 24.

Companies Winding-up Voluntarily

MANCHESTER CELLULOSE FINISHES, LTD. (C.W.U.V., 30/11/35.) By special resolutions for purpose of reconstruction, November 21, Mr. Frank Dook, of 37 Cross Street, Manchester, appointed liquidator.

Company News

B. Laporte, Ltd.—An interim dividend of 5 per cent., less tax, has been declared.

Metallgesellschaft of Frankfurt, in which the British Metal Corporation is interested, announces a 5 per cent. dividend for the year to September 30 last, against 4 per cent. for the previous year.

J. C. and J. Field.—An interim dividend is announced on the preference shares at the rate of 7 per cent. per annum, less tax, in respect of the half-year ended September 30, 1935, payable on December 9.

Sulphide Corporation.—The payment is announced of 2½ per cent. on the ordinary shares (the first since 15 per cent. for 1928-9) and 10 per cent. on the preference shares (against 2½ per cent.) for the year to June 30 last.

Dartmoor China Clay.—The report for 1934 shows a profit of £3,618; to this is added £7,653 brought in after deducting tax £383, the sum of £10,888 remains to be carried forward. The bank overdraft which stood at £2,500 in the last account was reduced during the year to £750, and has since been extinguished.

Anglo-Iranian Oil Co.—The directors have decided to resume interim dividends on the £13,425,000 ordinary stock with a payment of 5 per cent., less tax, on December 16 next. This is stated to be the first interim distribution since 5 per cent. was paid in 1930. For the whole of 1934 the dividend was 12½ per cent., compared with 7½ per cent. in each of the two preceding years.

Books Received

Electrolytic Oxidation and Reduction. By S. Glasstone and A. Hickling. London: Chapman & Hall. Pp. 420. 25s.

Precipitated Chalk. By A. P. Wilson. Birmingham. John & E. Sturge, Ltd. Pp. 62.

Modern Views of Atomic Structure. By Dr. Karl Rast. Trans. Dr. W. O. Kermack. London: Frederick Muller, Ltd. Pp. 154. 7s. 6d.

Official Publications Received

Report of the Fuel Research Board for the Year ended March 31, 1935. London: H.M. Stationery Office. Pp. 188. 3s. 6d.

Forthcoming Events

LONDON

Dec. 2.—Society of Chemical Industry (London Section). "Industrial Disinfectants." J. Gibson. 8 p.m. Burlington House, Piccadilly, London.

Dec. 3.—British Association of Refrigeration. Sessional meeting. Hall of the Institute of Marine Engineers, 85-88 Minories, London, E.C.3.

Dec. 4.—Society of Public Analysts. "Air-damped Balance," W. N. Bond; "Colorimetric Analysis by Means of the Photo-electric Cell," N. Strafford; "The Characters of 1935 Halibut Liver Oils," Norman Evers, A. G. Jones, and Wilfred Smith; "The Composition and Examination of Tanganyika Arrow Poison," W. D. Raymond. 8 p.m. Burlington House, Piccadilly, London.

Dec. 5.—The Chemical Society. "The Free Energy of Hydration of Some Aliphatic Compounds," J. A. V. Butler and C. N. Ramchandani; "The Polar Effects of the Halofens in Aromatic Combination," G. Baddeley, G. M. Bennett, S. Glasstone and B. Jones; "Aliphatic Substitution and the Walden Inversion," E. D. Hughes, F. Juliusburger, S. Masterman, B. Topley and J. Weiss. 8 p.m. Burlington House, Piccadilly, London.

Dec. 6.—Institute of Fuel. Discussion on "The Adequacy of our Fuel Supplies in a time of National Emergency," opened by H. A. Humphrey. 7 p.m. British Industries House, Marble Arch, London.

Dec. 6.—Society of Dyers and Colourists (London Section). "Anodic Dyeing of Metals." Capt. Windsor Bowen. London.

BIRMINGHAM

Dec. 2.—Chemical Society. "Alkaloids—General Ideas and Methods." Professor G. Barger. 5 p.m. Chemistry Lecture Theatre, University, Birmingham.

Dec. 3.—Electrodepositors' Technical Society. "Methods of Heating Solutions in Electrodeposition." J. Binns. 7.30 p.m. James Watt Memorial Institute, Gt. Charles Street, Birmingham.

Dec. 5.—Institute of Metals (Birmingham Section). Joint meeting with the Birmingham Section of the Institute of Physics. 7 p.m. James Watt Memorial Institute, Birmingham.

BRISTOL

Dec. 2.—Society of Chemical Industry and Institute of Chemistry (Bristol Sections). "Problems of River Pollution," Dr. A. Parker. 5.30 p.m. University Chemical Department, University, Bristol.

Dec. 5.—Society of Chemical Industry (Bristol Section and Chemical Engineering Group). Visit to the Lithographic Printing Works of E. S. & A. Robinson, Ltd. 2.30 p.m. "Grass Silage and Silos," A. W. Ling and W. R. Peel. 6.30 p.m. Informal dinner. 8 p.m. Hort's Restaurant, Broad Street, Bristol.

GLASGOW

Dec. 6.—Ramsay Chemical Dinner. 7 p.m. Central Station Hotel, Glasgow.

LEICESTER

Dec. 4.—Society of Dyers and Colourists (Midlands Section). Discussion on "Stains." T. H. Jones, A. J. Hall and Dr. E. R. Trotman. Leicester Technical College, Leicester.

LINCOLN

Dec. 6.—Institute of Fuel (East Midland Section). Joint meeting with the Lincoln Engineering Society. "Sources of Fuel Oils." Dr. A. R. Bowen. 7.30 p.m. Technical College, Lincoln.

LIVERPOOL

Dec. 6.—Society of Chemical Industry (Liverpool Section). "Adsorption and Catalysis." Professor E. C. C. Baly. 6 p.m. University, Liverpool.

MANCHESTER

Dec. 4.—Manchester Metallurgical Society. "Notch Brittleness in Metals." J. G. Docherty. 7 p.m. Engineers' Club, Albert Square, Manchester.

Dec. 5.—Institute of Chemistry (Manchester Section). Chairman's Address. Annual dinner and dance. "The Manchester," Ltd., Manchester.

Dec. 5.—The Institute of Vitreous Enamellers. "Sandblasting." F. W. Wilson. 7.30 p.m. Y.M.C.A., Peter Street, Manchester.

Dec. 6.—Chemical Society. Joint meeting with the Food Group and the Manchester Section of the Society of Chemical Industry and the Chemical Society. Symposium on "Micro-organisms and Foodstuffs." 2.30 p.m. College of Technology, and 7 p.m. Engineers Club, Albert Square, Manchester.

NEWCASTLE-ON-TYNE

Dec. 6.—Institute of Chemistry (Newcastle Section). Joint meeting with Bedson Club. "The Interaction of Molecules and Surfaces." Professor J. Lennard Jones. 6.30 p.m. Newcastle-on-Tyne.

NOTTINGHAM

Dec. 2.—Institute of Fuel (East Midland Section). Visit to the Mining Laboratories of University College, Nottingham, and to the Research Laboratory of the Fuel Research Station, Shakespeare Street. 7 p.m.

WORKINGTON

Dec. 6.—West Cumberland Society of Chemists and Engineers. "Reinforced Concrete." W. A. Green. 7 p.m. Workington.

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